

AN INVESTIGATION OF THE ENVIRONMENTAL ASPECTS OF FORMS
AND MATERIALS IN RESIDENTIAL DESIGN

by

AMEL SADIE AL-JASSANI

Diploma, The University of Baghdad, 1957

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ART

College of Architecture and Design

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1965

Approved by:


Major Professor

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INTRODUCTION

Background to the Problem

The main contributions of forms and materials in the home are that they are the major elements which comprise our visual environment and which affect our feelings. With and through good selection and organization of forms and materials in accord with the principles of good design, people feel physically, psychologically, socially and economically satisfied; thus creating an environment for happier living. However, forms and materials do more than provide for the satisfaction of our feelings. They shape the space in which we live; they affect the light reflection; they play an important part in the selection of colors; and, they determine the transmission of noise. Colors depend upon light for their existence, and the relationship of color, light, space, and acoustics are affected by forms and materials.

In recent years the attention of those concerned with the need for research into environment stems from two sources. First, the ever-increasing speed with which basic design decisions must be made if we are to meet the creative challenges of our developing era, and, second, the dearth of basic data which serves our creative demands.

Much research has been undertaken in this vital direction. This announcement concerning the formation of the Center for Environmental Research comes from Clifford Douglas Stewart, Boston architect.

Our aims are to:

1. Investigate and systematically record the controllers of physical environment.

2. Investigate and systematically record the energizers of psychological environment.

3. Analyze the many forms of growth environment and attempt to develop appropriate design direction.

4. Investigate and systematically record the potentials of Construction Technique and Material Design.

5. Analyze the use and the potential of Graphic Communication and the Visualization Process.¹

Industry and various professional groups have done research in attempting to understand the physical requirements of man with respect to residential forms and materials. In contrast little has been done in regard to the psychological requirements. Most areas in the home are used many hours for relaxation, conversation and other activities which require suitable forms and materials.

Most noteworthy of the research on residential design was the physiological research on posture which affects not only the designing of chairs, desks and tables but also the manifold relative arrangements of space, furniture, and placement of appliances that make it so necessary for us habitually to assume certain postures.²

Specialists in the Department of Housing and Design at Cornell University have worked with the College of Architecture on a number of studies relating to the design of housing to actual family living patterns, as well as to attitudes and preferences. In one of such studies, household activities carried on simultaneously by different family members were

¹Emerson Goble. Reactions on Research. Architectural Record. February, 1964. p. 9.

²Richard Neutra. Survival Through Design. New York: Oxford University Press, 1954. p. 153.

analyzed to determine their space requirements and interrelationships. Household equipment and furniture should be designed to provide for the comfort, convenience and safety of the individuals using them.¹ (See Table 1, Appendix).

The extra physical and emotional requirements of forms and materials are now being recognized. The following statements are significant:

Form, planes, and lines shape the space in which we live by defining its physical limits, texture adds to its character. Over and above their fundamental work in making our environment livable, these plastic elements have qualities that add to or detract from the beauty and individuality of homes. From these qualities, all parts of our homes derive much of their character, their emotional impact or mood.²

Structure, the physical material to which we immediately react, is significant as form. It is only as form that we can relate it to ourselves.³

In view of these statements it is evident that the person working in the field of interior design, either practicing directly or as an educator, needs to know the principles upon which interior forms and materials depend for artistic effect.

Since the author plans to be a specialist in interior design, she wants to study forms and materials and become familiar with their effects upon people, so that she can apply this information to the residential interiors of the families with whom she works.

¹Center for Housing and Environmental Studies. Cornell University. Ithaca, N. Y. 1959. p. 3.

²Ray Faulkner and Sarah Faulkner. Inside Today's Home. Revised edition. New York: Holt, Rinehart and Winston, Inc., 1966. p. 122.

³Robert Woods Kennedy. The House and the Art of its Design. New York: Reinhold Publishing Corporation, 1953. p. 483.

Need for the Study

Several factors indicated a need for this study. First was the author's limited knowledge about forms and materials. Although interested in them her understanding was too limited for predicting a desired effect. The ineffective forms and materials of many interiors became a factor. The dearth of studies and research in this particular field was also considered. Finally, the fact that people are interested in making their homes attractive, and successful selection and organization of forms and materials makes an important contribution toward that goal, helped establish another need for this study.

Scope of the Study

The scope of forms and materials in interior design is very broad for it involves man and all his needs: emotional, social, cultural as well as physical satisfactions. A study which would consider forms and materials as it related to man in all these aspects would embrace physiology, psychology, sociology, physics, and engineering.

As a procedure for this study, one-hundred copies of a questionnaire were prepared and submitted to Cornell University students (see Appendix C). The purpose of this was to obtain first-hand information as to the general opinion concerning preferences and advances or improvements needed. Library research was conducted so as to compare my ideas with others in this field and other fields, in order to better evaluate this study. From these procedures and from my own observations and experiences, principles were developed, and some of them were applied in designing a house and in selecting forms and materials for its living room (see Plate VII).

Since the author was accompanying her husband to Cornell University, she took the opportunity of being there to complete her course requirements and to work on her thesis in absentia.

In addition to the resources of the Architecture and Farrell libraries at Kansas State University, those of the Mann, Seton, Engineering, Architecture and Physics at Cornell University were used for research. Information was also obtained from the Center for Housing and Environmental Studies at Cornell University.

The number of questions on the questionnaire was limited in order to encourage returns. Questions 1, 2, 3, and 4 were related to residential design in general. Questions 5, 6, 7 and 8 were related to forms and questions 9, 10, 11 and 12 to materials. The number of returns (60) made valid interpretation and analysis possible. Answers have been used to show some students' reactions. These reactions have been evaluated.

To give a historical background to residential forms and materials, the author wishes to separate one part dealing with some aspects of the past and of the present forms and materials, pointing to the factors which have made up that history to show how these factors with the predominance now of one, now of another, have acted to give rise to various conceptions to forms and to materials.

Hypotheses and Basic Assumptions

Since the study was concerned with the investigation of the environmental aspects of forms and materials in residential design, the following hypotheses were developed:

1. The satisfaction of any residential design is created when its

forms and materials are functional, beautiful, economical and individual.

2. The size, shape and direction of any form in the home determine our physical and psychological reactions.

3. The texture of any material in the home affects us physically and psychologically.

4. The effect of space can be created or limited with certain forms and materials.

5. Light, color and acoustics in our homes can be absorbed or reflected by different forms and materials.

SOME ASPECTS OF THE PAST AND OF THE PRESENT FORMS AND MATERIALS IN RESIDENTIAL DESIGN

Historical Factors Which Affect Residential Design

The history of residential design is the history of the manifold determining elements which have influenced residential building through the centuries and have included the entire range of human interests. Residential design has responded to such a variety of needs. Its development would mean writing the history of civilization itself, recounting the multiplicity of factors which make up that history and showing how these factors, with the predominance now of one, now of another, have acted in concert to give rise to various conceptions of forms and materials. These factors are:

1. Physical factors which include the physical needs of people and the availability of materials in nature.

2. Social factors based on the economic conditions of the country and individuals who sponsor its construction, as well as on the prevailing

way of life and the relations between the family and others.

3. Intellectual factors that are concerned not only with what a society and individual really are, but also with what they want to be: their dreams, religious faiths and aspirations.

4. Technical factors which refer to the progress of science and its application to handicraft and industry, and particularly to the techniques of construction.

5. Esthetic factors that include the preference for certain types of materials, fashions in interior decoration, use of colors and the dominance of forms and their organizations.

The First Man-Made Houses

Houses begin everywhere with men facing raw nature, trying to find shelter, comfort and security. Wright stated, "Man by nature desired to build as the birds were meantime building their nests, as insects were building their cities, and as animals were seeking their dens, making their lairs, or burrowing into the ground."¹ Gowans added, "Like birds piecing a nest together, or beavers piling up dams; caves and huts and wigwags taking form far less from human will or pleasure than at the raw dictates of nature."²

Man by innate animal instinct got his first lessons. He got ideas of form from nature, native to the place where he lived. He sometimes

¹Frank Lloyd Wright. The Future of Architecture. New York: Horizon Press, 1953. p. 37.

²Alan Gowans. Images of American Living. Philadelphia and New York: J. B. Lippincott Company, 1964. p. 4.

lived in stone caves and sometimes in trees. While still living in caves, he learned how to make utensils out of wet clay, which taught him something of form. Then he made whole caves out of wet clay which were baked by the sun. So, once upon a time, he moved into his first man-made house.

Better forms of houses, then, had come from the sticks, by leaning upright sticks together at the top, then covering them with skins of the animals. Later he made more roomy houses by putting sticks upright and crossed them at intervals with other horizontal sticks, covering all with various forms of mats from dried grasses. Then he had to contrive the roof. The shape of the roof was what affected the general aspect of their houses. "Man soon came to feel that, if he had no roof in this sense, he had no house."¹ And the roof-shelter became the most important factor in the making of the house, because every roof had to be formed strongly enough to hold the interior space from wall to wall.

Early historic walls and ceilings of Sumeria and Babylonia were constructed in sun-dried brick and stone. Arches were first used in these countries both to span openings and for ornamental purposes. "Then, therefore, stone was available and could be piled up to make a wall, a rectangular hut with an opening in one side might suggest itself, whereas, the plasticity of clay might lend itself to the construction of a circular building."²

¹ Wright, op. cit., p. 40.

² Nathanid Lloyd. A History of the English House. London: The Architecture Press, 1931. p. 8.

Plate I illustrates three types of Neolithic houses. Figure 1 shows the circular houses in Khirokitis, Cyprus, with a beehive-shaped vault of mud-brick and a raised wooden sleeping-platform which created, for the first time, an upper floor. Figure 2 illustrates a sun-dried brick house in Hassuna in Iraq. Figure 3 illustrates Tholoi houses which were also beehive buildings, but they were entered through an outer, rectangular compartment.¹

Ancient Egypt's Residential Forms and Materials

Nature had endowed the land with large quantities of hard and durable building stones, such as granite, basalt and diorite. Ancient Egypt had made use of such native materials in its palaces and houses, as well as in temples and tombs. "Egyptian architecture was a noble kind of stone flesh."²

Although religion played an important part in the life of every inhabitant because it was believed that life on earth was but temporary, historical records show that from the earliest dates the Egyptian home was furnished with chairs, stools, tables and other articles of great beauty. A Greek historian informs us that from the earliest dynasty furnishings were of the greatest luxury, indicating an extravagant mode of life. The Egyptian cabinetmakers and wood workers understood their material. They knew that wood would warp, twist, split and shrink, so

¹ Seton Lloyd, World Architecture. London: McGraw-Hill Book Company, Inc., 1963. p. 16.

² Wright, op. cit., p. 45.

EXPLANATION OF PLATE I

Figure 1 shows the Neolithic village of circular houses. The circular, domed structure, whether of brick or snow, is one of the primary structural forms that persist until the present day.

Figure 2 shows a farmhouse at Hassuna in Iraq during the Neolithic era. It was made of sun-dried brick.

Figure 3 shows the Tholos-type house in Apachia in Iraq. Tholoi were beehive houses entered through an outer rectangular compartment. This explains that from earliest times, man felt the need for indirect entry to his living space. (Taken from Seton Lloyd, World Architecture, London: McGraw-Hill Book Company, Inc., 1963. p. 16.)

PLATE I

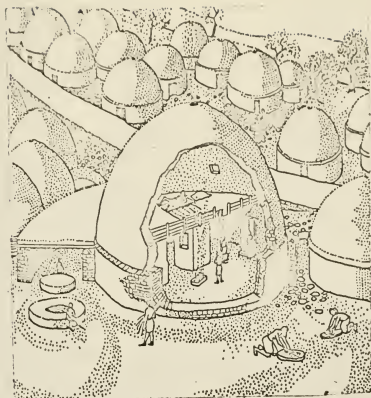


Fig. 1



Fig. 2

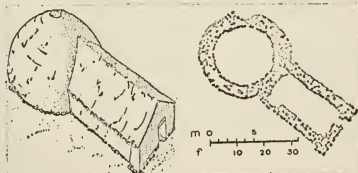


Fig. 3

they treated their shapes and constructions so as to correct these defects. Wood was used because it was native. Comfort was considered in making furniture which was shaped to fit human form.¹

Plate II illustrates a group of buildings for King Zoser of the third dynasty. It shows the pyramid complex. The group comprises a funerary temple, chapels and residential quarters in the rectangular enclosure.²

Rectangular forms and straight lines dominated Egyptian architecture. They had little knowledge of the principles of arch construction, so that vaulted ceilings and arched doors or window openings were not used. They used only the stone wall, column, or isolated support and the lintel.³

It seems that all the stone buildings were dedicated to religious or monumental purposes; there were a few exceptions such as the palaces of El-Amarah or the astonishing Middle Kingdom fortress at Buhen in Nubia. All the private dwellings, and the overwhelming majority of regular buildings, were constructed of mud-brick with palm-trunk roofs and limited by these materials to comparatively simple architected forms.⁴

¹ Sherrill Whiton. Elements of Interior Design and Decoration. New York: J. B. Lippincott, 1963. p. 27.

² Lloyd, op. cit., p. 28.

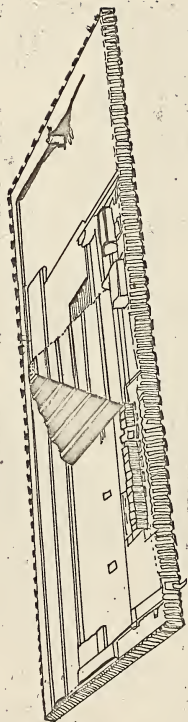
³ Whiton, op. cit., p. 27.

⁴ Lloyd, op. cit., p. 44.

EXPLANATION OF PLATE II

This plate shows the Zoser complex Sakmara, 2773 B. C., in Ancient Egypt. This comprises a funerary temple, chapels and residential quarters for the king's use in a vast rectangular enclosure. (Taken from Seton Lloyd, World Architecture. London: McGraw-Hill Book Company, Inc., 1963, p. 40.)

PLATE II



Classical Forms and Materials

After Ancient Egypt, the Greeks used the same forms and materials but added the wooden truss. They used columns for support and as a feature on the outside of a building. The Greeks seemed to have attained to so high a degree of sensitivity to form, line, proportion and to the principle of symmetry.¹

"Little remains of Greek dwellings, and the records that are obtainable are those of historians. The houses were small, built around courtyards, and were without windows, the light entering through the doors of the rooms."² But archeologists have often tried to prove that Greek houses were designed by the use of geometrical formulas.

Greeks were lacking the sensitivity of materials, "Greeks consciously evolved flower shapes in stone, but worked stone also as wood. After the Dorians and Ionians they seemed to have less sense of materials than other peoples."³

The Roman builders used the same principles in using the column, lintel and truss. In addition, they developed the arch built of radiating wedge-shaped stones. From the arch the Romans evolved the barrel vault or curved ceiling, and the dome. These principles were applied to the residential design. In addition, the residences of the patricians were elaborately planned, with rooms for every purpose and arcaded courtyards

¹Whiton, op. cit., p. 48.

²Ibid., p. 48.

³Wright, op. cit., p. 55.

containing gushing fountains. The courtyard was roofed and the center of this roof was pierced by an opening that permitted daylight to enter.¹

"Of Roman houses there are three types, two of which are characteristic. These are the corridor-type and the central court-type."²

"The Roman dwelling-house was primarily a court with smaller rooms around it, all in the ground story."³ Similar to the Greek, the rooms were constructed without windows because of the hot climate.

Plate III illustrates the Greek and Roman furniture. The classical furniture was made of marble, bronze, iron and wood. The legs of chairs and tables often showed the use of disk-turnings or animal forms. The chairs had back rails curved in a concave form, roughly following the curve of the human back. The legs were curved, the front legs curving forward and the back legs curving backward. They also used architectural forms in their furniture.⁴

The classical design was also popular from 1700-1800, especially in Anglo-Saxon countries, France and central Europe, which intended to revive Greek and Roman architecture.

¹Whiton, op. cit., p. 55.

²Lloyd, op. cit., p. 2.

³Russell Sturgis. History of Architecture. New York: Doubleday, Page & Company, 1916. p. 401.

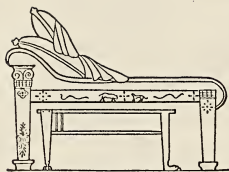
⁴Whiton, op. cit., pp. 48-66.

EXPLANATION OF PLATE III

This plate illustrates different kinds of forms and materials used in Greek and Roman furniture.

(Taken from Sherrill Whiton. Elements of Interior Design and Decoration, New York: J. B. Lippincott, Inc., 1963. p. 49.)

PLATE III



Greek Bedstead with Table



Basin



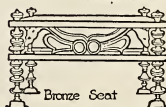
Roman Chair



Roman Folding Stool



Greek Chair



Bronze Seat



Roman Lamp



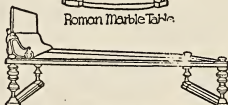
Roman Marble Table



Folding Stool



Roman Tripod



Roman Bed



Pompeian Table

GREEK AND ROMAN FURNITURE.

"Middle Ages," the Dark Period of
Residential Design

During the Middle Ages the social and political conditions permitted little comfort or luxury in houses. Most people lived in stone houses roofed with thatch. It was not until the thirteenth century that the medieval castle began to look less like a fortress and to have a few conveniences and comforts. It was no longer necessary to consider strength before convenience in homes. People began to choose situations for dwellings that were beautiful and satisfying.¹

During the Middle Ages the windows of the house had wooden shutters because the glass for windows did not become common in dwellings until the fifteenth century. The stone walls were often bare or covered with rough plaster. The ceilings of the rooms showed the exposed beams or trusses of the roof construction. The rooms were heated with open fires in the middle of the room. When the room became filled with smoke, the resident made his escape through a door, window or hole in the roof. The discomforting condition stirred the Gothic builders to create the fireplace and chimney. It was at this time that the fireplace became the symbol of the home. Plate IV illustrates a small Gothic bedroom with its large fireplace. This was taken from an illustration in a fifteenth century manuscript.²

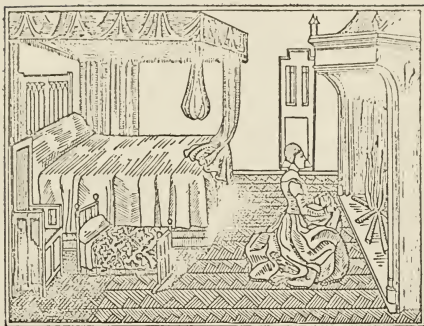
¹ Ibid., p. 95.

² Whiton, op. cit., p. 101.

EXPLANATION OF PLATE IV

This plate shows a small Gothic bedroom, taken from an illustration in a fifteenth century manuscript. It was at this time the fireplace and the hearth became the symbols of the home. (Taken from Sherrell Whiton, Elements of Interior Design and Decoration. New York: J. B. Lippincott, 1963. p. 101.)

PLATE IV



"Renaissance," the Rebirth of Residential Design

In the thirteenth century, as has been mentioned, people had been taught that man was master of his own destiny and that he should not be the intellectual slave of either Church or State. This movement toward individualism affected the character of his residence, permitting the earliest design of a domestic type in which comfort, convenience and beauty were the important considerations, rather than safety, strength and protection.¹

† During this period many smaller palaces and villas were built by wealthy merchants. The architectural forms of the classic era, such as, pedestal, column, pilaster, entablature, pediment and panel, were applied and were employed for both structural and ornamental purposes. These features helped in producing rooms of great formality, dignity and magnificence. The thick stone walls were pierced by doors and windows having deep reveals without trim. The openings were treated either with a flat lintel or had a segmental or semicircular arch. Ceilings were high and they were heavy in scale. Wood panelled and coffered ceilings also were used. Tile, brick and marble were the materials used for floors. The rooms became smaller and were distributed and used for the purposes that they are today.²

In the early Renaissance, furniture was little used and was large in dimensions. By the middle period, a more general demand for greater

¹ Ibid., p. 113.

² Whiton, op. cit., p. 113.

richness and comfort in the movable furnishings of the house was seen, and as great thought was placed upon entertaining and social intercourse, the general design and arrangement of the furniture was made with these activities in view. The cabinetmakers followed the principles of the Gothic predecessors in applying architectural forms to the ornament and decoration of their furniture. Plate V shows some of the Renaissance furniture during the sixteenth century in Italy. All furniture was large and heavy and their woods were often of an inferior grade.¹

The Industrial Revolution and its Influence on Residential Forms and Materials

With the nineteenth century came the dawn of the Machine Age. Until that time all goods had been processed and assembled by hand. Shops were generally located in the home of the proprietor. When production increased the shop moved from the home into separate quarters - the factory - and the number of articles produced increased rapidly.²

By 1820, there was little demand for hand-crafted products, and machine-made limitations flooded the market. This created technological unemployment, long working hours, child labor and poor urban living conditions. There were also esthetic problems to the designs which the machine produced. These social and esthetic problems proved to be catalytic in the development of new domestic designs that were expressive of the

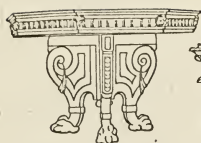
¹ Ibid., p. 122.

² B. Arthur Gallion and Simon Eisner. The Urban Pattern. New York: D. Van Nostrand Company, Ltd., 1963. p. 63.

EXPLANATION OF PLATE V

This plate shows some of the Renaissance furniture during the sixteenth century in Italy. All furniture was large and heavy, and their woods were of an inferior grade. (Taken from Sherrill Whiton. Elements of Interior Design and Decoration. New York: J. B. Lippincott, Inc., 1963. p. 122.)

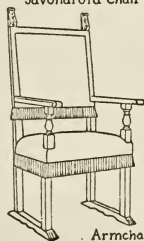
PLATE V



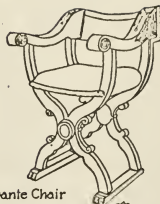
Florentine Table



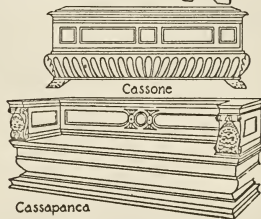
Savonarola Chair



Armchair

Sgabello -
Candelabrum

Dante Chair



Cassone

Cassapanca

SIXTEENTH-CENTURY ITALIAN FURNITURE.

materials the machine had produced and to meet the social problems that the Industrial Revolution had created.¹

The influence of the Industrial Revolution was first felt in England. The new industrial economy brought exploitation of the poor and, with poverty, came the slums. These slums, row upon row of crowded worker's houses in the shadow of the factory, all were added to the traditional slums of the seventeenth century in Europe. Engrossed in the technical processes of industrial production, the homes of the people were neglected. The houses and the residential apartments took different forms in various countries, but they all had one characteristic in common—that is excessive land coverage.²

Twentieth Century Residential Forms and Materials

In this century, the residential design has had three overlapping phases.

1. The "Modernistic," which came in the 1920's, was characterized by clumsy forms with a sincere attempt to put a stop and an end to the past. Heavy chairs, tall bookcases and angular tables were used.

2. The "Machine Modern," introduced in the 1930's, still persists. The designers again attempt to take full advantage of machine production and materials to simplify homes and furnishings.

3. The "Naturalism" is the leading trend today. This begins with nature that surrounds us. Here wood for houses and furniture has come

¹Whiton, op. cit., p. 385.

²Gallion and Eisner, op. cit., p. 69.

into popularity. New materials with nature-like textures are favored.

Among the famous architects that contributed to the development of the twentieth century residential design were: Frank Lloyd Wright, Le Corbusier, Walter Gropius, Richard Neutra, and Mies Van der Rohe.

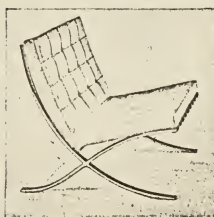
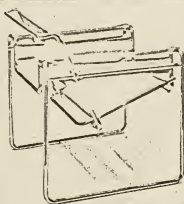
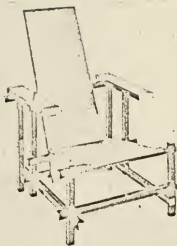
In general, Contemporary Residential Design necessitates irregularity in room shapes, which in turn produces problems in furniture arrangement. Much furniture is now part of the wall construction. Symmetrical compositions and groupings are usually difficult to attain. The multi-purpose rooms permit variations of materials and forms in the same room. Rock, wood, stone, plastic, glass and synthetic materials are used. Fireplaces are considered from the functional point of view rather than the decorative, and they are made in different forms and from various materials. The furniture is also considered from the functional point of view of comfort and fitness to purpose. Plate VI illustrates six of the twentieth century chairs. The upper left which is sculptural in form was designed by Gerrit Rietveld in 1917 using articulated planes of painted wood. Upper right and center are three chairs that show the development of Marcel Breuer's work during the 20's; the wood chair, 1924; the chrome-plated steel tube chair, 1925; and the cantilevered steel tube chair, 1928. Lower: the Van der Rohe steel tube chair, 1929. This chair of chrome-plated steel bars and quilted leather has strongly influenced the chair designers during the past five years.¹

¹ Whitton, op. cit., p. 403.

EXPLANATION OF PLATE VI

This plate illustrates six of the twentieth century chairs. The upper left which is sculptural in form was designed by Gerrit Rietveld in 1917 using articulated planes of painted wood. Upper right and center are three chairs that show the development of Marcel Breuer's work during the 20's; the wood chair, 1924; the chrome-plated steel tube chair, 1925; and the cantilevered steel tube chair, 1928. Lower: the Van der Rohe steel tube chair, 1929. This chair of chrome-plated steel bars and quilted leather has strongly influenced the chair designers during the past five years. (Taken from Sherrill Whiton. Elements of Interior Design and Decoration. New York: J. B. Lippincott, Inc., 1963. p. 418.)

PLATE VI



PRINCIPLES OF DESIGN AND THEIR APPLICATION
TO RESIDENTIAL DESIGN

Analysis of Design Principles for
Satisfying Human Needs

The house should be designed for satisfying our physical and emotional needs. The physical needs include: adequate space, safe structures, sound conditioning, proper sanitation, good heating and cooling and proper lighting. The emotional needs include: pleasant surroundings, secure atmosphere, inspiring environment, colorful surroundings and restful locale. "Yet the construction of a contemporary scene which would gratify human needs instead of frustrating them, which would further the smooth functioning of man's nervous system instead of imposing an intolerable strain on it, is a problem that will most certainly not be solved by lucky accidents."¹

Plate VII illustrates a house which is planned to meet the above requirements. It is designed for a couple living in Palm Beach, Florida. Their desire was to have a show-case house for elegant living with much entertaining.

Different kinds of indoor-outdoor group-living spaces have been shaped to meet their needs and purposes.

Bedrooms and baths are well-segregated on the second floor. Each has adequate space for dressing and sufficient closets. The walk-in closet serves the wife's demand since she is a fashion model.

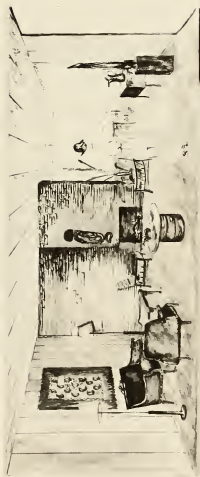
¹Neutra, op. cit., p. 23.

EXPLANATION OF PLATE VII

This plate illustrates a house planned to meet the demands of a family living in Palm Beach, Florida. The living room was designed and furnished with comfortable furniture which was arranged for group living. Materials were chosen to please the senses. Sensitive balancing of visual weights was used.

PLATE VII

A SHOW CASE HOUSE FOR ELEGANT LIVING
PALM BEACH, FLORIDA



Second Floor Plan



Forms & materials in
A Living Room



First Floor Plan

100 100 100 100

100

100

100

100

The kitchen is strategically located near the dining area, carport and back door to help to simplify getting meals and doing the laundry.

Putting the out-of-doors in the right place has been considered in designing this house for a typical flat city lot. The plan is strictly rectangular, formal and symmetrical yet handsomely contrasting with the natural surroundings. The two wings here are joined by two covered areas open to the court. This court helps to provide good ventilation and makes living comfortable in a mild climate like that of Florida.

The space in the living room is adequate in size and appropriate in shape. Comfort is considered in designing the furniture. They have been shaped to fit the human scale and proportion. The furniture is arranged for family use and entertaining.

A constant human need is to have the attention held by intricate or robust forms, then released by simple or quiet ones. The fireplace here is the dominant element. It is large and prominently placed, and its importance is strengthened by the arrangement of furniture, plants and sculpture.

The asymmetrical balance in this room is typical of twentieth century design. It is a sensitive balancing of visual weights without exact repetition from side to side.

Materials have been chosen and shaped to please the senses and to extend a hospitable welcome. The basic materials here are wood and stone, both of which have a natural variety in texture in addition to their physical and psychological durability.

A wide range of materials enhances the design. The predominant areas are the walls and the ceiling which are moderately smooth, against

which the very rough and very smooth textures are accented. The smoothest is used in the window glass and the roughest in the carpet and in the stone.

This room demonstrates a happy union of Louis XVI furniture, an oriental rug and modern draperies, carpets and accessories. Although each has its own distinctive character, they have in common such qualities as refinement and elegance.

According to this illustration, forms and materials together with light and color comprise our visual environment, and they are the means through which designers, in accord with the principles of design, create an environment for satisfying human needs.

Question 1 asked on the questionnaire was "Do you feel that selection and organization of forms and materials are the first consideration in residential design?" The students were asked to give their opinion either an affirmative or negative reply to the two stated answers, or they might give other reasons. Forty-seven per cent of the answers indicated "yes;" 23 per cent indicated "no;" and 30 per cent answered differently. The majority of these thirty stated that they felt that all the elements mentioned were necessary without any preferences, while others answered as follows:

"I feel that the character of the people for whom you are creating a home should have first consideration. The forms should be arranged around their activities;"

"I think functional design would be important to me as well as those pure design features mentioned;"

"First consideration in residential design is functionality;"

"No, because functional relationship between spaces is most important."

The majority of the answers showed that forms and materials are the first consideration in residential design. However, the last four returns indicated that people prefer their design to be functional. It is the opinion of the author that by good selection and organization of forms and materials functionality would be provided.

Contrast and Unity

This principle is often misinterpreted as meaning "Variety in Unity," or as "Formed of Parts that Make a Whole."

A design is an orderly arrangement of forms, lines, shapes, colors, spaces and textures, forming a unified composition. Interest in a design is attained by the introduction of contrasts, which without these features is dull and monotonous; with them in excess it lacks unity and becomes confusing and restless. Tiredness of the same existing forms may overpower us; we may want to get rid of it all. We need a change. So our fatigue may be concerned with the shape and material of our furniture, houses and the texture of different materials and the whole aspects of our environment.

All nature and all good designs show variety in unity. Our bodies are made up of unified parts. Our hands, for example, are made from different units but they are related to the whole. Our houses are also made of rooms in which each one differs from the other, yet we can not treat each as an isolated unit. We have to think how it relates to other areas, to the view and out-door living space and to the sun and wind. Piecemeal design is seldom successful.

The house should be unified because a unified house satisfies the

desire for secure atmosphere and for wholeness which can not be found in a furniture store, or in a house which is lacking this uniformity.

Unity in our houses may be achieved by:

1. Contrasts as produced by straight, curved and irregular lines, and by line direction and movement. The designer's function is to introduce just the proper amount of contrast and movement in his design to create the effect of unity, and to avoid the extremes of dullness and confusion. Contrasts can be as little noticeable as in the texture of a china dish over a table, or highly noticeable as a rough rug over a polished floor.

2. The differentiation of a single form characterizes the expression of one room, quite a different form may serve for another, but from any basic idea all the formal elements of design are in each case derived and held together in scale and character.¹

3. Sameness or repetition is less interesting--having all the house from the same material and form.

4. Similarity and harmony mean repetition while introducing some variety. For example, the furniture of a room might be of one cover material but their structures and shapes are different.

5. Enclosures help unify parts of a home by separating them from their surroundings. Fences around gardens and frames around pictures are examples.²

¹Frank Lloyd Wright, Buildings, Plans and Design. New York: Horizon Press Publishers, 1963. p. 13.

²Faulkner and Faulkner, op. cit., p. 89.

6. One way of keeping unity is to have a flow of continuous surface, or as Wright expressed, "Let walls, ceilings, floors, now become not only party to each other but part of each other reacting upon and within one another; continuity in all, eliminating any merely constructed features as such, or any fixture or appliance whatsoever as such."¹

7. Another way of keeping unity and variety is to have a single dominant theme all over the home, accompanied by a secondary one. The basic theme, for example, is rectangularity which can be expressed in the larger elements—the shape of the room, the rugs, the design of the windows and the design of the doors. In the contrast is the second theme of curves which can be produced in the shapes of the furniture and the patterns of draperies, plates, bowls and table lamps.

8. Every composition in the house must be characterized by a connection between all its components. "Two equivalent and adjacent statues, two identical houses, two stories of the same height, one above the other, do not form a unity, but duality."² Also, all geometric forms that the eye can easily divide into two parts are to be avoided, such as a rectangle which can be divided into two squares.

The Relation Between Form and Function

It has been said that utility dictates shape. Nearly every form in

¹Frank Lloyd Wright. The Natural House. New York: Horizon Press, Inc., 1954. p. 19.

²Bruno Zevi. Architecture as Space. Translated by Milton Gendel. New York: Horizon Press, 1957. p. 193.

the house has its utilitarian aspects and these ought to be the basic consideration in its design.

All forms should be capable of performing their functions. Horatio Greenough, an American sculptor of the eighteenth century, once wrote that man-made forms should follow function just as plant forms do.¹ The architect Louis Sullivan, also declared this same point of view. His triad, Form, Function and Expression, seems more likely because once the designer has a definite goal in mind, he has a control over form, function and expression. Thus, for example, function within traditionalism is difficult of achievement. Plate VIII illustrates Sullivan's triad which shows the relationship between form, function and expression. "Ideally the form of the house is conditioned both by its internal requirements and by such external factors. The entire individual house is undergoing a complete re-evaluation of its purposes of functions."² Finally, Frank Lloyd Wright advanced that form not only follows function, but that form and function are one and the same thing, a concept he called "Organic Work." He said,

Architecture not alone as form following function in Lieber Meister's sense but architecture for the spirit of man for life as life must be lived today; architecture spiritually (virtually) conceived as appropriate enclosure of interior space to be lived in. Form and function made one.³

¹Kate Rogers. The Modern House. New York: Harper & Brothers Publishers, 1962. p. 94.

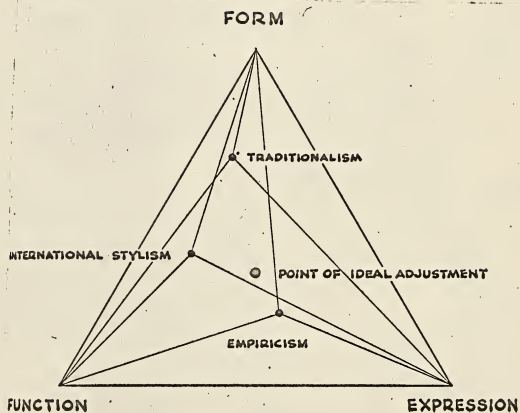
²Talbot Hamlin, F.A.I.A. Forms and Functions of Twentieth Century Architecture. New York: Columbia University Press, Vol. III, 1952. p. 37.

³Frank Lloyd Wright. The Natural House. New York: Horizon Press, Inc., 1954. p. 29.

EXPLANATION OF PLATE VIII

This plate illustrates the Sullivan triad which shows the relationship between form, function and expression. (Taken from Robert Kennedy. The House. New York: Reinhold Publishing Corporation, 1953. p. 39.)

PLATE VIII



There is a steady and strong progression of thought, not only in architecture but in the art field in general, that beauty of form is relative to the degree in which an object meets most fully the demands of function, and that an object with a high level of efficiency is most often esthetically satisfying.¹ The author believes that there is an exception to this, and there is no necessary connection between the level or type of need and the design. George Nelson in his book, Problems of Design, has mentioned this point of view. He said,

Let us say that the 'need' in question concerns a vessel to hold liquids. The response to the need—a designed and manufactured object—may be a perfectly adequate container with no esthetic interest, or it may be a thing preserved through the ages as an incomparable work of art. In other words, functional sufficiency is no guarantee whatever of good design.²

Use, beauty, economy and individuality should be united to produce a complete satisfactory design. A desk is completely satisfactory only when it is useful, economical and beautiful to an individual because it fits the user's anatomy.

Responses to question 2 "What makes a piece of furniture, or a particular room, or a special house satisfactory to you?" were as follows:

If it is functional; meets my needs and requirements	25%
If it is beautiful; gives me pleasure	15%
If it is economical; easy to clean and to repair	0%
If it is individual; has a character of its own	18%

¹Rogers, op. cit., p. 94.

²George Nelson. Problems of Design. New York: Whitney Publications, Inc., 1957. p. 9.

The other 42 per cent of the returned answers were stated differently.

These were the ideas listed to achieve the effect:

Nine per cent indicated that they considered functionalness a part of a beautiful design;

Three per cent indicated that the furniture or room would have to combine function, beauty and individuality;

Thirty per cent stated that a combination of the above items: function, beauty, economy and individuality should be considered before deciding or choosing any form or material.

The result of this question showed that a combination of function, beauty, economy and individuality should be considered before selecting any form or material. These elements were recommended although several factors would make a difference in the way of ranking them.

Selection and organization of forms and materials for a completely satisfactory design are complex. Study and analysis of specific and general requirements are important. In selecting draperies, for example, attention might first be focused on utility--how well the material controls the transmission of light and extreme out-door temperature, the privacy it affords and its sound qualities. Then we might look at the price while thinking about durability. We have also to think about color, texture and pattern. The major difficulty centers around the fact that several of the criteria are opposite each other. If this happens, it is sensible to give up the qualities of lesser importance and buy the article having those deemed most important.

Balance is a Major Principle

Everything in nature is in balance, and balance is a major principle in all aspects of life. Neutra in his book, Survival Through Design, pointed out that the farther man has moved away from the balanced integration of nature, the more his physical environment has become harmful.¹

Balance means an equilibrium. It is achieved when interplaying forces, attractions, or weights lend towards resolution.² In a residential design, balance means the "visual weights" of architecture and furnishings. This is determined by the psychological effect it has on us. Everything in the home is a psychological factor in design, but the effect of each item varies markedly depending on its size, form and texture, as well as other factors such as light and color. For example, a small unusual or unexpected form can balance a large piece of plain furniture.

In furnishing a home, balance can be achieved by the arrangement of windows, doors, fireplaces, or other details around a visual center. But there are many factors that make the balance of a room or of a home ever-changing. These are:

1. The people that are using the room. When people move about, they change the equilibrium by the areas to which they go.
2. The amount and the kind of light that enters the room, whether it is natural or artificial.

¹Neutra, op. cit., p. 24.

²Faulkner and Faulkner, op. cit., p. 92.

3. The composite of all the little things that happen during the day.¹

There are three types of balance: symmetrical, asymmetrical, and radial. Symmetrical balance or formal balance means that two identical weights or attractions are placed at equal distances from the center. The effect of this balance is quiet and reposed because it is easy to appreciate and quick to see, since one side is the same as the other. It tends to emphasize the center, and the resultant division into two equal parts usually reduces the apparent size. It is very simple and this simplicity contributes to its popularity. The balance of most forms such as furniture, some houses, and household equipment is symmetrical to fit our symmetrical bodies. But the arrangement of these symmetrical forms in a symmetrical manner, for example, doors in centers of walls, seldom are logical because two equal areas are left that may be difficult to furnish unless the room is very large.

The asymmetrical balance, which is called informal, is achieved by the arrangements of unlike forms which is called informal, unequal distances from the center. This is also known as "occult or active" balance. This type of balance is often found in houses designed to harmonize with their natural surroundings and to use space most efficiently. In this balance, the physical and visual weights occur near the center and counter-balance lighter ones farther away. Since unlike objects are at unequal distances from the center, asymmetry stirs us more quickly and vigorously.

¹Ibid., p. 93.

It suggests movement, spontaneity and informality. It provides more freedom and flexibility in arrangements of forms and of materials, for utility as well as for beauty and individuality.

Eighty-eight per cent of the students returning the questionnaire stated in reply to question 3 that they preferred asymmetrical balance, seven per cent preferred symmetrical balance, and five per cent stated differently. The following shows their preferences:

"Either, properly handled, is acceptable."

"Depends on the space available and sense of rhythm to be created."

"Depends on how the remainder of the house is furnished and arranged."

According to these answers, the majority of people preferred an asymmetrical balance. It is believed because the trends of contemporary living are toward informality, asymmetrical balance is more preferable in home design as an environment for the informality of the space, as well as providing more freedom and flexibility in the arrangements of forms and materials. However, the author recommended that symmetrical forms and patterns be used in an asymmetrical arrangement.

Birren in his book, Color, Form and Space, has mentioned, "Symmetrical forms hold greater interest and are more insistent in perception than irregular or asymmetric forms."¹

The third type of balance is the radial balance that results when all parts are balanced and repeated around the center. In our homes we can see this balance in such circular objects as plates, lighting fixtures,

¹ Faber Birren. Color, Form and Space. New York: Reinhold Publishing Co., 1961. p. 23.

round tables and some textile patterns, radial balance makes its own distinctive contribution in many small objects.¹

A Scale and Proportion

Scale and proportion are essentially methods of relating physical structure to environment. When we say, for example, that a room or a house is excellent because all parts are "in scale," we mean that the elements making up the structure have a pleasing relationship to the whole and to each other; and that they are in good proportion. A very small chair next to a very massive one would be "out of scale." This principle is very important when considering in the residential design. Furniture which seems too small for a room can be arranged in groups, so the size of the group becomes the unit for comparison.

Human scale acts as a yardstick for the sizes of rooms, furniture and equipment. If the home has a suitable scale, we look and feel like normal human beings. The size of the human figure should fix ever proportion of a dwelling or anything in it. Human scale is always a true building scale. So the height in the newer buildings should be accommodated to no exaggerated established order nor to impress the beholder, but only to comfort the human being. "A building wholly of monumental scale, as in so many examples, is empty and silly; but the monumental scale, continually related to elements on a human scale, is magnificently effective."²

¹Faulkner and Faulkner, op. cit., p. 95.

²Levi, op. cit., p. 197.

Proportions of the human body are the basis of all design. Pythagoras of Samos once wrote the inscription, "Man is the measure of all things." Plate IX illustrates some of the minimum measurements essential to good design. These measurements are based on the height and the reach of the persons using that room, furniture, or equipment.

In the fifteenth century Leonardo Da Vinci illustrated Euclid's formula which is now known as "The Golden Rule." It consists of dividing a line or a form so that the smaller portion has the same ratio to the larger as the larger has to the whole. The progression $1:2:3:5:8:13:21:34\dots$, in which each term is the sum of the two preceding ones, illustrates this relationship, and provides more satisfaction.

Scale also helps us appreciate size. McLean mentioned, "Scale is a matter of detailing as well as of size. Two chairs can be the same size but one looks smaller because the parts are slender and refined."¹

Contemporary houses are considerably smaller than the houses of years ago, so is most contemporary furniture and equipment. There are several reasons for this:

1. Many new materials call for such small scale because of their flexibility and also because of their expensiveness.
2. The introduction of heating, mechanical ventilation and cooling.
3. Shortage of workers and their high wages.

¹Faulkner and Faulkner, op. cit., p. 107.

EXPLANATION OF PLATE IX

Figure 1 illustrates standard proportions for easy chairs, couch and a long coffee table. (Taken from Julius Panero. Anatomy for Interior Designers. New York: Whitney Library of Design, 1962. p. 16.)

Figure 2 illustrates kitchen dimensions which are based on the height and reach of persons using this room. These dimensions are for average women. (Taken from Ray Faulkner and Sarah Faulkner. Revised edition. Inside Today's Home. New York: Holt, Rinehart and Winston, Inc., 1960. p. 66.)

PLATE IX

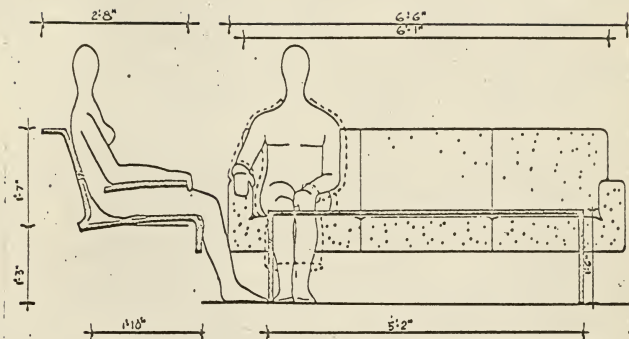


Fig. 1

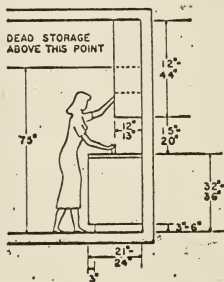
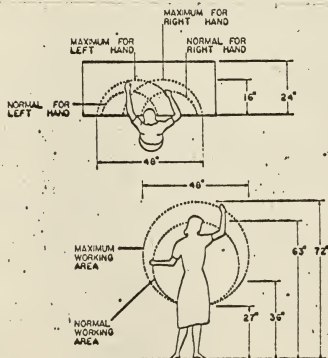


Fig. 2

Emphasis as an Important Principle

Emphasis is another principle in residential design. Without emphasis the home might be monotonous, lacking interest. Emphasis is concerned with giving significance to each part of the home and to the whole, calling more attention to the important parts than those of lesser importance.

Students returning the questionnaire answered question 4 "Does any part of your house or your apartment or your room call your attention more than another?" These students were asked to check for either an affirmative or negative reply. If their answers were "yes," they were asked to indicate what factor makes that part more noticeable. The author gave four conditions by which a particular design could be emphasized. Freedom was also given to the students to indicate what they might suggest.

Sixty-three per cent of these students answered "yes," and twenty-two per cent of them answered "no."

Those with affirmative replies answered as follows:

Holds the largest forms and/or materials	5%
Contains unexpected forms and/or materials	15%
Contains worthy collections of forms and/or materials	28%
Contains contrasts of forms and/or materials	15%

The other 15 per cent answered differently. The majority stated that all the above conditions contain an esthetically pleasing combination, while others referred to color as an important factor in giving such attractiveness.

From the result obtained, it seemed that most people preferred their

homes to contain worthy collections of forms and materials. Those with negative answers have approved that some of the homes lack interest. It is believed that too much attention and interest, as well as non-important qualities in a home make it unsatisfactory. Emphasis in a home lacking a natural interest can be built up by one of the above conditions or more than one alternative.

The Faulkners in their book, Inside Today's Home, pointed out that in order to emphasize our homes we might:

1. Decide on the levels of importance of different parts of the home. Play up each according to its significance.
2. Arrange the parts in proportion to their importance. An object gains if "built up" with others less important.
3. Limit the number of interesting centers. One dominant and two or three subdominant are about as much as a typical room can take.
4. Use the attraction of visual weights, such as large forms, bright materials, contrast or opposition of forms and materials.¹

The emphatic form may be a fireplace, or a worthy collection of furniture or rugs. If we do not have these things in our homes, a wise procedure might be to concentrate spending on one large, important piece of furniture or on a painting, to locate it prominently and augment its attractiveness by grouping smaller furniture and accessories near by. Still less costly is achieved by painting walls, ceiling, and floor with dull colors to be less noticeable.

¹Ibid., p. 105.

Rhythm Contributes to Beauty

Rhythm is the continuity and the organized movement of forms, lines, shapes and materials. It is one of the most expressive principles in design, and it is a means through which an underlying unity and evolving variety can be gained. "The eye likes to travel, it seeks variety and new things to look at, but likes to know where it is going. It therefore appreciates rhythm."¹

Rhythm contributes to the beauty of homes in several ways:

1. Unity and harmony are gained by rhythmic repetition and progression. It is exemplified in time by the repetition of our heartbeats and progression of one season into another.
2. Contrast of vertical and horizontal lines both in the direction of these lines and in their character.
3. Surface and material contrasts.

Repetition and progression are the two primary ways of developing rhythm. Repetition can be produced by repeating rectangles, curves, shapes, or textures; but it can be given more interesting complexity by alternating shapes, colors, lines, forms, or textures.

Progression is a sequence or transition produced by increasing or decreasing one or more qualities. Because progression suggests not only movement but changing movement toward a goal, it is more lively and dynamic than is repetition. It is also a little more difficult to manage and

¹Whiton, op. cit., p. 166.

more likely to attract notice, which can be used only in important parts of the home.¹

Plate X, Fig. 1, illustrates identical squares at regular intervals which establish a strong stable rhythm through repetition. Putting black circles between these squares develops a strongly accented rhythm through the alternating repetition of two contrasting shapes and weights. A simple progression from square to narrow rectangle produces a more complex evolving rhythm. Plate X, Fig. 2, illustrates a living room in which progressions in size, shape and direction are noticeable. Above the fireplace is a horizontal rectangle that is the largest expanse of uninterrupted wall. Next comes the wall to which the vine clings, smaller in size and moderately vertical in feeling. This progression is followed by the smallest unit, the vertical pier behind the built-in end table. Accompanying these size and shape changes is a change of direction and location. The ledge and seat parallel the center wall and angle out into the room to add one more step to the angular sequence of position of the walls behind. The repeated pattern of the concrete blocks emphasizes each change.²

¹ Faulkner and Faulkner, op. cit., p. 99.

² Ibid., p. 97.

EXPLANATION OF PLATE X

Figure 1 illustrates rhythm which is established by the repetition of squares at regular intervals. Putting black circles between squares develops a strongly accented rhythm through alternation. A simple progression from squares to rectangles produces a more complex evolving rhythm. George McLean. (Taken from Ray Faulkner and Sarah Faulkner. Revised edition. Inside Today's Home. New York: Holt, Rinehart and Winston, Inc., 1960. p. 98.)

Figure 2 illustrates the walls in an Arizona living room which have a pronounced progression from large to small size, from horizontal to vertical shape, and in their angular placement. The uniform concrete blocks generate a steady quiet repetition. Blaine Drake, architect. (Taken from Ray Faulkner and Sarah Faulkner. Revised edition. Inside Today's Home. New York: Holt, Rinehart and Winston, Inc., 1960. p. 100.)

PLATE X

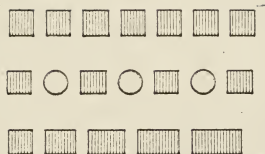


Fig. 1

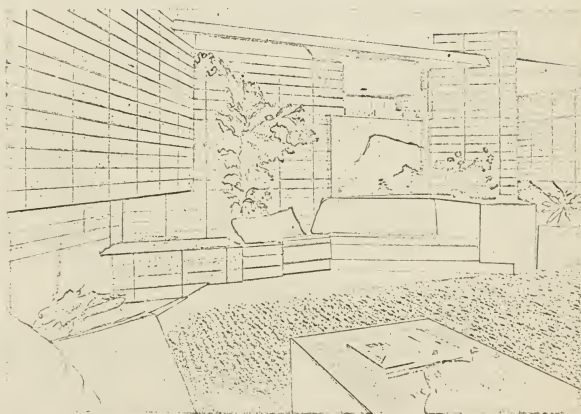


Fig. 2

THE ENVIRONMENTAL ASPECTS OF FORMS AND THEIR APPLICATION TO RESIDENTIAL DESIGN

The Visual Concepts of Forms

According to Arnheim, LeCorbusier once said, "Our eyes are constructed to enable us to see forms in light."¹ According to Birren, Vernon wrote, "A formless percept is unthinkable, and it is impossible to perceive something formless, should such ever occur."²

Form may be defined as three dimensional shape or structure. "Form" usually refers to internal as well as external structure. "Figure" usually applies to form as determined by lines which bound or enclose a thing. "Shape" like figure, suggests an outline, but carries a stronger implication of mass or body. The visual elements of form include outline, plane, volume or mass, light and shade, color and texture.

Our visual concepts of many forms are characterized by structural symmetries which are brought out most directly by certain aspects of the object. It is, however, that no representation of an object will ever be valid visually and artistically unless the eyes can directly understand it as a deviation from the basic visual conception of form.

Plate XI illustrates a visual object represented in a chair. The top view (a) is similar to the seat. The front view (b) shows the shape of the chair's back, and its symmetrical relation to the front legs. The

¹Rudolf Arnheim. Art and Visual Perception. Berkeley: University of California Press, 1954. p. 73.

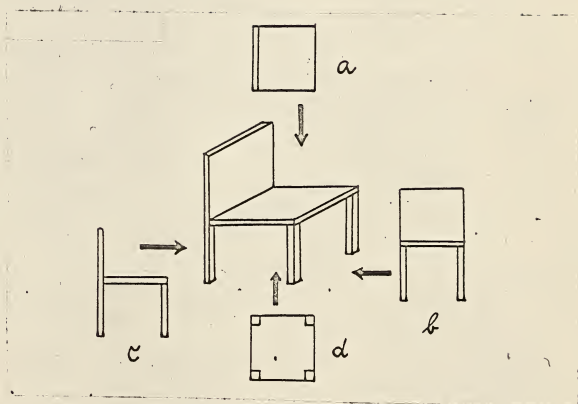
²Faber Birren. Color, Form and Space. New York: Reinhold Pub. Co., 1961. p. 30.

EXPLANATION OF PLATE XI

This plate illustrates the normal visual conception of a chair. All the illustrations shown are necessary and make part of this conception because a person's visual concept of an object is generally based on the totality of observations from any number of angles.

(Taken from Rudolf Arnheim. Art and Visual Perception. Berkeley: University of California Press, 1954. p. 73.)

PLATE XI



side view (c) hides almost everything, but gives the important rectangular arrangement of back, seat and legs more clearly than any other view.

Finally, the bottom view (d) is the only one to reveal the symmetrical arrangement of the four legs attached to the corners of the square seat. All this information is absolutely necessary and makes part of the normal visual conception of the object.¹

Form is a fundamental law; it is the way things appear to the perceiver. When one perceives an object, that object tends, psychologically, to take on form; and forms establish themselves and persist, independently of the stimulus, as a property of the perceiving organism.²

While physical concept of any form may remain constant, the visual impression of that form may vary. Plate XIII illustrates a number of illusions which indicate some remarkable workings of the visual process. The eye tends to judge shape and form in terms of surroundings.³

Eyes Prefer Simple Forms. The most satisfactory forms are the simple ones. The visual process is one that seems to demand and prefer simplicity. Forms that are slightly irregular or which have gaps in them will appear quite regular or complete in their after images.

Neutra stated,

Mental economy evidently favors what can be easily conceived, visualized, memorized, and communicated. Thus, a square, a circle, or an equilateral triangle is more readily defined, envisioned, and recalled than a figure of irregular shape and anomalous proportions.⁴

¹Arnheim, op. cit., p. 73.

²Floyd H. Allport, Theories of Perception and the Concept of Structure. New York: John Wiley and Sons, Inc., 1955. p. 113.

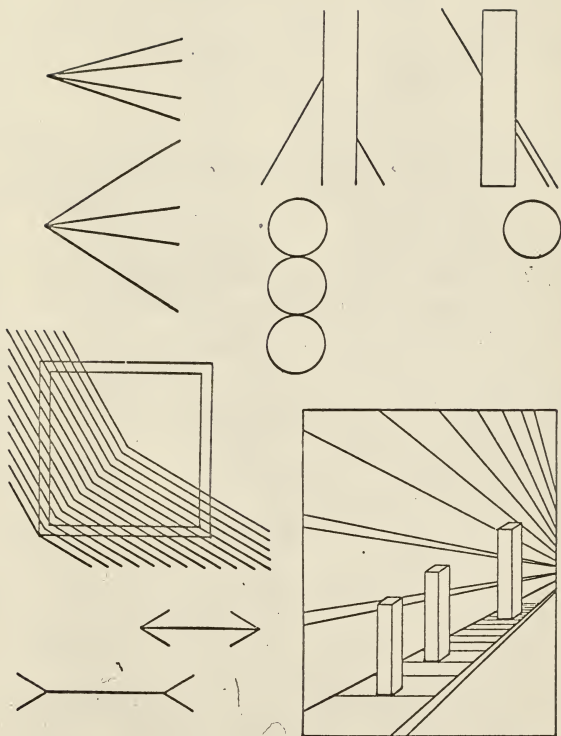
³Ibid., p. 31.

⁴Neutra, op. cit., p. 123.

EXPLANATION OF PLATE XII

This plate illustrates a series of illusions. The eye tends to judge shape and form in terms of surroundings. Here we see angles which do not appear the same, circles that appear unequal, straight lines that appear slanted, lengths and spaces that do not appear equal and blocks which appear of unequal height. (Taken from Faber Birren. Color, Form and Space. New York: Reinhold Publishing Co., 1961. p. 31.)

PLATE VII



Because the eye forever seeks symmetrical forms and concentrates on them, so the simple forms are the easiest to perceive. "Man's preference for simple form relates to his natural sense of equilibrium. The eye struggles hard to bring the object of its interest into the center of its field of view and then to see it."¹

Wright stated,

Geometry is the obvious framework upon which nature works to keep her scale in 'designing'. She relates things to each other and to the whole, while meantime she gives to your eye most subtle, mysterious and apparently spontaneous irregularity in effects. So, it is through the embodied abstract that any true architect, or any true artist, must work to put his inspiration into ideas of form in the realm of created things.²

So geometric forms such as a square, which is simple when it is turned forty-five degrees becomes a new object—a diamond which balances on an angle rather than on a base and because of the obliqueness of its sides, it is more dynamic and perceptually less simple. The difference in this simplicity can be shown by the fact that children find it easier to draw a square than a diamond. Results of the Stanford-Binet intelligence test show that the average five-year-old is able to copy a square, whereas, only the average seven-year-old can successfully copy the diamond.³

According to Birren, Wilhelm Ostwald was concerned with the psychological and perceptual elements of design and form. He noted the following: if dots are presented in a small and irregular way, they seem to lack

¹Birren, op. cit., p. 18.

²Frank Lloyd Wright. The Future of Architecture. New York: Horizon Press, 1953. p. 53.

³Arnheim, op. cit., p. 68.

simple conviction and require some explanation for the viewer to be satisfied. If the dots are presented in the form of a circle, square or hexagon, they appear right and normal and are easy to perceive.¹

Stable Forms are Easier to Perceive. In visual work the dominant axis established framework of orientation. For example, in a room the orientation of walls, floor and ceiling determine the position of vertical and horizontal. Anything on the wall may be seen hanging obliquely in relation to the framework of the room, or it may be seen as upright. Let us consider that the object is a picture, so as long as the vertical axis of the picture coincides with the inherent verticals of the field of vision, the picture will look upright and stable.

Plate XIII, Figs. 1 and 2, illustrates that the same forms may be given different interpretation. Forms assume different shapes even though geometrically nothing has been changed. Even though both forms share the general property of triangularity and squareness, their shapes are different. Form (A) rises from a stable basis to a sharp peak, while form (B) balances heavily and precariously on a pointed foot.

Plate XIII, Fig. 3, illustrates an experiment done by David Kalz. Four cylindrical forms were placed on a revolving surface. A group of adults were then given similar forms and asked to place them on an adjacent table. Most of the adults placed the cylinders as in position (A); a few as in position (B); but no other variations occurred.

When nine cylinders were used, the adults arranged them in position

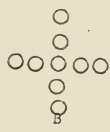
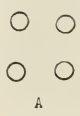
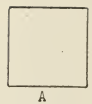
¹Birren, op. cit., p. 17.

EXPLANATION OF PLATE XIII

Figures 1 and 2 illustrate two geometric shapes, a triangle and a square. They seem to be stably resting on one side (version A) and precariously on one corner (version B).

Figure 3 illustrates two experiments devised by Kalz. In the two arrangements, positions A and B will be preferred. It would appear that the eye likes the stable positions best. (Taken from Rudolf Arnheim. Art and Visual Perception. Berkeley: University of California Press, 1954. p. 19.)

PLATE XIII



(A) more than in position (B) and again no other variations.¹

Temperament, Interest and Attitudes Direct and Determine the Content of Visual Perception. Perception seeks meaning in what the eye sees. The same design might give different impression to different people depending on their temperaments, interests and attitudes. "Perception not only tries to simplify what is seen but it strives to give meaning to it."²

Forms seen in the upper part of the visual field tend to look relatively smaller and heavier than in the lower part. Distances, as well, seem different in length depending on how far they are from the perceiver. In architecture, effects of distance may be emphasized. It is common practice to increase the height of lower floors of a building and to decrease the height of upper stories. This makes for a wholly natural effect which agrees with average experience in perception.

Several investigators have noted certain left to right tendencies in perception. The direction from the bottom, left to right, is more natural than the other way around. Similarly, the direction from top left to bottom right is the easier and simpler. These findings open up research in the psychophysics of esthetics. Picture composition, advertising copy and sculpture, as well as architecture, are more satisfactory if they are treated according to the eye movement in exploration, and if,

¹Ibid., p. 19.

²Ibid., p. 34.

for example, pleasing pictures are reviewed right to left they will be unsatisfactory.¹

According to Birren, Kohler discovered that in perception general relationships are more easily remembered than static or fixed qualities. It is much easier to visualize the general appearance, weight, size and shape than some specific detail.²

Application of Visual Concepts of Forms to Residential Design

What kinds of visual concepts do designers use to represent objects? Forms, planes and lines are the most basic elements in the visual world through which designers create a variety of designs. Although a line theoretically has but one dimension and a plane has two, the words are frequently used to describe the dominant directions or the outlines of a form as when the "lines" of furniture or houses are said to be pleasing, and as when the roof plane is said to be an active directional force.

The visual forms can be causative forces affecting our feelings. In Plate VII the horizontal sofa and chairs establish a subdominant easy repose in a living room. A markedly different kind of eye movement and of feeling is introduced when one looks at the dominant fireplace. A few diagonals are seen in the legs of the furniture and the outlines of the lamps. In varying degrees these diagonals bring a greater feeling of activity than do either horizontals or verticals. Circles are used in the circular table with its rounded accessories, in the lamp shades and

¹Ibid., p. 34.

²Ibid., p. 35.

in the vases and plates. These bring a unified fluidity inherent in circles and spheres. However, when we look at this room with all possible forms horizontal or vertical, diagonal or curved, we begin appreciating what each type of shape can contribute. These forms are fundamental in the "language of vision" as consequential in home design as in painting and sculpture.

Effects of Size and Direction. The size and the direction of any form determines its expressive character. Scientists and artists in studying the expressiveness of line and form have come to such generalizations as the following:

Horizontals tend to be restful and relaxing, especially when long. If short and interrupted, they become a series of restless dashes.

Vertical forms and lines express a stabilized resistance to gravity, a poised uprightness. If high enough, they evoke feelings of aspiration and ascendancy.

Diagonals are as active as a runner's body.¹

When these forms were shown in question 5 and the students were asked to check the one that was preferable, the answers were as follows:

I prefer (A) because a high ceiling provides a feeling of loftiness and greatness.	33%
--	-----

I prefer (B) because a low ceiling provides comfort and relaxation and is more economical.	27%
--	-----

I prefer (C) because a sloping ceiling provides an environment suggesting activity.	28%
---	-----

Twelve per cent indicated that their preferences depended on which room was being considered, its function, its size and the dominant material used, and that a combination of these types of ceilings might serve the purpose.

¹Faulkner and Faulkner, op. cit., p. 129.

The author considers the low ceiling more preferable today because it is more economical and provides friendliness and comfort. However, the high percentage of those who indicated the preference for the high ceiling depends on how these students feel and how they enjoy their life.

The Faulkners in their book, Inside Today's Home, mentioned that we have to emphasize verticals: high ceilings, tall doors and windows, or upright furniture, if we want to have people feel like standing straight and tall or to enjoy a suggestion of loftiness. We have to emphasize horizontals: low ceilings, broad openings and stretched-out furniture if we want people to lounge comfortably, relax and act informally. Diagonals must be emphasized: sloping ceilings, oblique walls or furniture, and textiles with diagonal lines if we want a home environment suggesting activity.¹

Effects of Geometricals. Form in the home is most obviously determined by its basic shape. Although each shape has its own identity in home design, there are no limits to the ways in which the shapes can be varied and combined for specific desired effects.

Responses to question 6 asked on the questionnaire, "Different types of geometrical shapes have different effects upon us. Which types do you prefer to dominate your house?" were as follows:

I prefer rectangular forms because they are inherently more stable and simpler than other forms. 77%

I prefer circular forms because they are self-contained and they produce the effect of movement. 3%

¹
Ibid., p. 130.

I prefer triangular forms because they introduce excitement and adventure.

13%

Seven per cent noted that they preferred a combination of all kinds without putting emphasis on one shape.

Although rectangularity may dominate a home as these answers showed, we do not want it to appear monotonous. The interior designer, therefore, is interested in creating a variety of physical and emotional effects. From the literature it is evident that a combination of different geometrical forms makes a contribution to that effect.

That rectangularity is typical of the larger forms in homes today is evident by what one sees or reads. This form is prevalent not only in whole houses and rooms but in such furniture as beds, tables and cabinets, as well as, in many sofas, chairs and benches. The Faulkners mentioned some reasons for this widespread acceptance. These are:

They are easily handled on designers drafting boards, by carpenters and masons on the site and by machines in factories.

They fit snugly together--an important factor when multitudinous parts of buildings coming from many sources are assembled on the job and when space is becoming increasingly expensive.

They have a stable secure relationship of exactly 90 degrees, which gives a sense of definiteness and certainty.

They establish an incipient unity and rhythm when repeated.¹

Rectangular forms can produce great diversity, depending on their size, color, or texture and their stability. If we want motionless stability, cubes are indicated. For a feeling of movement directed along one line, a slender rectangle may be our solution.

¹Ibid., p. 123.

Triangles and pyramids are one of the most stable forms known in home design, but they express greater flexibility than do rectangles because the angles can be varied to suit the need. They are used in the ceiling, in tables and in landscapes. In gardens, diagonals increase apparent size because they imply motion.

Curves are the most variable of all forms. They bring together the lively combination of continuity and constant change. A slight curve in the exterior walls of a house give a suggestion of tremendous extent to a small building. It seems to pick up by its concave surface the whole surrounding landscape and to establish a relationship that carries its effect far beyond the actual bounds of the structure itself.

The Perception of Forms in Space

Space in this study is considered as that which is characterized by an extension in all directions. Space, as such, can not be seen, but the materials that enclose or suggest space are visible.

In actuality all space is filled. Man lives in space and is never without an awareness of it. We live with and move around form, but we live and move in space. According to Gibson, "The suggestion is that visual space, unlike abstract geometrical space is perceived only by virtue of what fills it."¹

Symmetrical forms hold greater interest and are more perceptible than irregular or asymmetrical forms. Also, convexity tends to win out

¹James J. Gibson. The Perceptions of the Visual World. Cambridge: Houghton Mifflin Co., 1950. p. 223.

over concavity. Convexity makes a better figure than concavity. Convexity tends to expand, while concavity contracts. Plate XIV shows outlines that are characteristic of traditional shapes in architectural forms. The bottom form is not often found and resembles a tent because most persons prefer the expanding form to the collapsing form.¹

Form-Space Relations. A house or a piece of furniture is never isolated from the environment or the space it fills. As a matter of fact, many interiors originally shaped, without immediate reference to environment, have required correction and alteration to make them fit where they were meant to belong.

Scott noted,

Architecture alone of the arts can give space its full value. It can surround us with a void of three dimensions; and whatever delight may be derived from that is the gift of architecture alone. Painting can depict space; poetry, like Shelley's, can recall its image; music can give us its analogy; but architecture deals with space directly; it uses space as a material and sets us in the midst.

But though we may overlook it, space affects us and can control our spirit; and a large part of the pleasure we obtain from architecture—pleasure which seems unaccountable or for which we do not trouble to account—springs in reality from space. Even from a utilitarian point of view, space is logically our end. To enclose a space is the object of a building; when we build we do but detach a convenient quantity of space, seclude it, and all architecture springs from that necessity. But esthetically space is even more supreme....He designs his space as a work of art; that is, he attempts through its means to excite a certain mood in those who enter it.²

¹Birren, op. cit., p. 26.

²Geoffrey Scott. The Architecture of Humanism. New York: Doubleday, 1954. p. 168.

EXPLANATION OF PLATE XIV

This plate shows outlines that are characteristic of ancient buildings: Roman, Gothic and Oriental. The bottom form is not often found and resembles a tent. Traditionally, most buildings have been based on convex shapes because most people prefer the expanding form to the collapsing form. (Taken from Faber Birren. Color, Form and Space. New York: Reinhold Publishing Co., 1961. p. 26.)

PLATE XIV



Seldom are forms seen in isolation from space and their relationships affect their characters. One of the clearest examples is apparent size. The same furniture will look larger in a small room than it will in one of large size. It will also be more conspicuous and usually seem larger if there are strong contrasts of texture, color and light between the furniture and the background.

In reference to question 7 asked on the questionnaire, "The apparent size and shape of any form in a house is determined by its relation to the space around. Have you ever noticed this?" The answers were:

Never	2%
Sometimes	40%
Always	58%

The majority of the students checked "always" which indicated that the student was generally aware of the relation between form and space.

The perception of forms in space is definitely related to human interpretation. According to Birren, Katz stated, "All visual percepts are influenced by knowledge that comes from experience."¹ Thus, texture as well as other factors operate as guides to the perception of forms in space. They include knowledge of size. Plate XV shows apparent movement or motion in the superimposition of one thing upon or in front of another, bringing about comparative brightness of detail as well as the muscular efforts of the eyes. These observations are applicable to many phases of home design.²

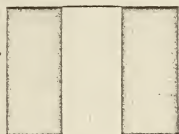
¹Birren, op. cit., p. 168.

²Faulkner and Faulkner, op. cit., p. 130.

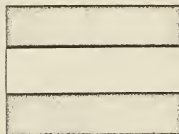
EXPLANATION OF PLATE XV

This plate illustrates that size and direction of any form operate as guides to its perception. Here the apparent size and shape of any form is determined by what happens within its outlines, as demonstrated by six treatments of the same rectangle. The upper right rectangle looks much larger and lower than its companion. (Taken from Ray Faulkner and Sarah Faulkner. Revised edition. Inside Today's Home. New York: Holt, Rinehart and Winston, Inc., 1960. p. 130.)

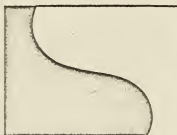
PLATE XV



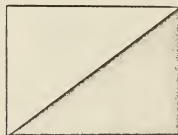
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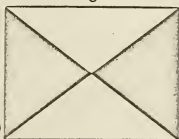
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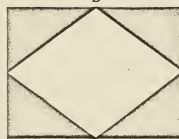
C



D



E



F

Creating Illusions of Space. Present-day homes have become smaller and ceilings lower. This decrease in dimension has become a challenge. Although a home may be small, we do not want it to appear small. The interior designer therefore is interested in creating an illusion of space.

Question 8 asked on the questionnaire, "If your room is small what do you think will make it look larger?" Responses to this question were:

I limit furnishings to those really needed.	48%
I keep dominance to a small scale.	25%
I use large glass areas.	11%

Most answers showed that furniture should be limited to those really needed to create illusions of space. Five per cent of the students failed to check which of the above ways might be used in order to achieve the desired effect or to suggest another way.

The remainder of the answers, eleven per cent, were stated differently. Half of this group indicated that a combination of more than one of the above ways might produce the effect, and the other have indicated as follows:

"Lighting and colors are used as modifiers of space."

"Create illusions of space by light colors."

"Avoid breaking up the space by using different shades."

Since this study deals with forms and materials, it is believed that although lighting and colors can be used to increase the apparent size of a room, forms and materials are used in many ways to enclose space economically, usefully, for satisfying the spirit and for making the space seem larger than its actual dimensions. The three ways which were stated in the questionnaire were some examples which could be used to achieve

such effects, and this study shows that the majority of the students think it is possible to increase the apparent space by limiting the furniture to those articles really needed.

The Open-Plan House. Several years ago many houses had separate rooms of ample size for group living. Today families have become smaller, help is hard to find and home entertainment is an active force. These conditions have led to increased interest in open-plan houses. Houses with a minimum of fixed floor to ceiling partitions and a maximum of flexible group living space have many virtues. Instead of tightly enclosed box-like rooms, space is organized as a continuing flowing entity designed for diverse purposes. Zevi indicated, "The ideals, history and achievements of modern architecture have been based on the open plan."¹ Internal wall partitions are thin, curved and freely movable. This creates the possibility of passing from the static plan of the traditional house to the free, open and elastic plan of modern houses.

Since all the above possibilities are provided by an open plan, as well as the fact that family activities are not isolated, it is thought that this provides an environment for agreeable living, for the spirit of man for life as life must be lived today.

But open plans have disadvantages also because the noisy activities interfere with those requiring quiet. These can be overcome in several ways. First is shaping the space with walls and furniture so that different functions are separated. Second is planning for noise control.

¹Zevi, op. cit., p. 143.

THE ENVIRONMENTAL ASPECTS OF MATERIALS AND THEIR APPLICATION TO RESIDENTIAL DESIGN

General Characteristics

Our homes are built of materials, each having special characteristics that indicate appropriate uses and effects. In general, we have different individual views about these materials. This is because everyone differs in some degree both physiologically and psychologically. Our senses permit us to notice the differences in materials. Some of them seem to absorb much warmth; some seem to reflect light; others are dust gatherers; some are sound reflectors; some are flexible; others are rigid; and, some are more restful, not only to the immediate touch but even from a distance.

Although materials have long been considered as fundamentals of home design, only recently have their potentialities beyond pleasantness or unpleasantness, important as these may be, become fully apparent. The home of today is built of new materials and has new construction. The effects of these materials on residential design are a fascinating study.

The possibilities and limitations of any material are determined by its physical properties, the methods by which it is formed, the intended use of the object and the skill and sensitivity of the designer.

Responses to question 9 asked on the questionnaire, "Our houses are built of materials, each having special potentialities and limitations that indicate appropriate forms, uses and effects. Which of these materials do you prefer to be dominant?" The answers were as follows:

I prefer wood because it is adaptable to many forms.	40%
I prefer stone because of its natural texture.	12%
I prefer glass because it creates indoor-outdoor relationships.	10%
I prefer concrete because it can be cast in varied shapes.	5%
I prefer brick because of its durability.	18%

Fifteen per cent of these students indicated differently. These were their suggestions:

"A combination of the above in a harmonious and balanced way."

"Depends on application to form, use, etc."

"Prefer wood to dominate but like a variety of materials and choice of materials suited to the design."

"Combination of wood and glass."

"My preference will depend on local conditions."

"Combination of stone, which gives a feeling of solidity and wood for warmth."

Wood. These answers showed that the majority of people prefer wood as the chief material in their houses. This may be because wood does not readily transmit heat or cold, which makes it a good insulator when used for walls or roofs, thus providing a feeling of warmth in winter and a feeling of cold during hot days. Besides this quality, wood is comparatively inexpensive, has remarkable strength in relationship to its size and shape and has beautiful color and grain.

However, wood, as other organic materials, has limitations. It rots, burns, decays, is attacked by insects and may swell, shrink or warp with changes in moisture content. The first step in overcoming these limitations is the consideration of other materials more suitable for certain uses.

For example, masonry or metal where there is a fire hazard, or concrete where there is excessive dampness.

Stone. Besides wood, stone was one of the earliest materials. Today it is used as a facing material. Like wood, it adds natural texture to the machine smoothness of twentieth-century homes. Since stone is resistant to fire, the fireplace is made of it. It is weather resistant, so it is frequently chosen for exterior divider walls and privacy walls, and is sometimes used as flooring. Wherever used, the crystalline structure and textures, and differing degrees of opaqueness and translucency, give a special visual and tactile appeal. Its use is somewhat limited by its cost and its weak resiliency, and because it changes as temperature changes, expanding and contracting.¹

Glass. The development of glass has altered our homes as much as any single factor. Few will deny the beauty of glass, it makes the outside seem to be the inside as well as the inside seem to be the outside.

Wright in his book, The Natural House, stated,

A super-material qualified to qualify us; qualifies us not only to escape from the prettified cavern of our present domestic life as also from the cave of our past, but competent actually to awaken in us the desire for such far-reaching simplicities of life as we may see in the clear countenance of nature.²

Architectural Forum contacted 36 leading architects to obtain an idea of the future importance of glass in the mind of the architect. "Two-thirds of them say that they will use more glass in the future. Only one

¹Rogers, op. cit., p. 50.

²Wright, op. cit., p. 54.

in four ways he will use about the same amount as he used today."¹ From this it can be seen that the popularity of glass as a building material is steadily increasing despite some of its difficulties. These difficulties are:

1. Large glass areas transmit great amounts of heat energy.
2. Glare caused by differences in lighting levels.
3. Low resistance to breakage through impact, twisting or bending and sudden temperature changes.

Much research has been done to counteract these disadvantages and glass is now used in residential design to provide a comfortable domestic environment.

Concrete. Its chief characteristics are its plasticity before it sets, and its durability after it hardens. It has become a valuable building material in our homes, where it is used for foundations, terraces, walkways and driveways. Because of its plasticity, many architects today are experimenting with the decorative qualities of a sculptured mold.

Three factors have tended to limit concrete to such basic parts of the home. First, it is not attractive in color or texture; second, its poor insulating quality; and third, its low tensile strength.

Brick. Bricks are in favor as artificial building materials. They are easily made by hand or machine and are less in weight than stone. They can be made in many sizes, shapes, colors and textures. Because of their texture as well as resistance to breakage, moisture and fire, brick is

¹ Growing Pains in Glass. Architectural Forum, Dec. 1956, p. 153.

frequently used for fireplaces and chimneys and for exterior wall surfaces where they last long.

Metal. Iron, copper, tin, brass, chromium, steel, and aluminum are used in many visible items in our homes. They are also used in items which are not visible.

Metal, like stone, glass and cement is inorganic and therefore does not burn, rot, or decay. It differs from them in that it may rust when exposed to moisture and air, and it has great tensile strength. Wright stated,

There is much new good in houses being built today and chiefly on account of the new freedoms afforded organic architecture, by the uses of steel and glass, miraculous materials. As a result of these, space is now freer, wider spans are easier; therefore more open spaces, made possible owing to steel in tension, and a closer relation to nature (environment) owing to the use of glass.¹

Metal, in general, is conductive and is high in malleability. It can assume any form and, with the exception of plastics, no other material can be shaped in so many ways. In the solid state it can be rolled, pressed or turned, bent, drilled or cut.

These, and many unmentioned materials such as plastics, ceramics and fabrics, humanize our homes because of their flexible responsiveness to our needs.

¹ Frank Lloyd Wright. The Natural House. New York: Bramhall House, 1954. p. 155.

Materials Affect us Physically and Psychologically

Our constructed environment which is built up from materials has great power over us. This environment can be friendly and provide happiness or can be hostile to our organism, on which it usually acts and reacts.

Complex inner stimuli derive from these materials. They might be well proportioned or might be a problem, thus creating tiredness. "Tactile stimuli have always been recognized as important factors in producing responses to architectural environment."¹ Thus, rough masonry, porous material and coarsely woven rugs and blankets will yield effects different from smooth, evenly polished surfaces, and soft, flexible materials provide effects different from hard and rigid ones.

Neutra explained this idea by comparing two spiralic lines. He said that there is a great similarity between the scroll of an ionic column carved in limestone and the spiral of a thin steel which, because of its material characteristics, contributes different psychological accents to each of these products, and the distinction is felt by the beholder.²

Referring to the qualities of materials, it may be said that texture describes how materials feel when touched.

Texture makes contributions to home design. A distinction is often made between actual textures in which the three-dimensional surface qualities can be felt, as in bricks and woolen tweeds, and visual in which a material

¹Neutra, op. cit., p. 151.

²Ibid., p. 75.

reveals a textural pattern under a smooth surface such as sanded wood, polished stone and many synthetic floor coverings.

Texture affects us in a number of ways. One of these effects is physical. Question 10 asked on the questionnaire, "The texture of the material affects us physically in everything we touch. For example, upholstery fabrics, if coarse and rough can be irritating. If too smooth and shiny they look and feel slippery and cold. How often do you feel such effect?" The answers were as follows:

Practically never	5%
Sometimes	36%
Always	59%

The result showed that the textures which are most generally noticed are neither excessively rough nor smooth, and that when frequently touched, they should be pleasant to feel. Resting the arms or the back against a very rough texture can be physically uncomfortable.

Certain tactile stimuli, combined with resilience affect our total feelings. For example, they may appeal to our fingers, to our feet, and to our backs. Therefore, sitting on an upholstered chair, lying on a springy sofa, or walking on piled carpets will contrast sharply with walking on a tiled floor or sitting on a plastic chair, because the latter registers firmness and is evaluated differently from the marked resilience of the former.

Light, flexible and smooth textures raise spirits and stimulate us to be active--unless they are all so monotonously smooth that they seem cold and weak. A predominance of moderate textures and resilient materials

are relaxing and comforting. Strong texture contrasts are stimulating. Closely related textures are quieting.

Richness, opulence, luxuriousness, wealth and affluence have often, in the past, been symbolized by smooth textures such as silks, satins, highly polished woods, lustrous metal and light-reflecting stones. Rough textures are used largely by the poor. Today, natural materials are preferred to fit in with the twentieth century conviction that stone should be treated like stone, and metal like metal.

The Visual Aspects of Materials. Esthetically, we are concerned with the results of materials being as they are, that is, only with materials as they affect us as visual entities. All materials may be beautiful; their beauty depends upon how well they are used by the designer.

The esthetic concept of any material is associated with the surface quality; thus the term texture is used. It has been defined as "visible non-uniformities in the reflectance of a surface which are obviously a physical property of the surface,"¹

Related textures or similar degrees of fineness or evenness, coarseness or ruggedness, form the most common textural harmonies. That is, smooth surfaces combined with smooth surfaces, or rough surfaces combined with other rough surfaces, can hardly be in conflict. Also either of them could be beautifully combined with surfaces of intermediate textures. Contrasts of rough and intermediate textures can be extremely well-visualized. Thus, rooms having all smooth textures are rather ordinary, and those having

¹Ralph M. Evans. An Introduction to Color. New York: John Wiley and Sons, Inc., 1948. p. 122.

all rough textures are overpowering. Also too much variety and too little dominance confuse the eyes.

Other Sensory Aspects. It has been said that odors of materials are most intimately held in memory and more quickly recognized again in later years than are visual impressions of the architecture involved. The livability of a room might be more strongly affected by the smells of upholstery, carpets and draperies than by the visual ornament of a table.

The future design of the environment for living and the future designers will content themselves to produce odorless homes. They will learn of the physiological effects due to the integral exhalations of their structural and finishing materials which form the enclosures of human life.¹

Mary likes and dislikes as well as the appreciation of certain materials and their characteristics have taken shape in childhood through our senses. That is through our taste, smell, hearing, as well as touch and vision.

Neutra stated,

Strange as it may seem, my first impressions of architecture were largely gustatory. I licked the blotter-like wallpaper adjoining my bed pillow, and the polished brass hardware of my toy cupboard. It must have been then and there that I developed an unconscious preference for flawlessly smooth surfaces that would stand the tongue test, the most exacting of tactile investigations, and for less open-jointed, and also more resilient flooring.²

¹Neutra, op. cit., p. 146.

²Ibid., p. 25.

Materials Give Character to Our Homes

Materials Affect Light Reflection and Absorption. The kind of surface of any material determines the way light is reflected. Reflection may be regular or specular diffuse, spread, mixed or scattered, depending on the texture. Since many kinds of surfaces are used in homes, it is well to know what to expect when light strikes these surfaces.

Question 11 was, "Texture affects light reflection and thus the appearance of any form. Very smooth shiny surfaces such as shiny polished metals reflect light, attracting attention and making their forms look clear and strong. How often do you use this effect to emphasize a particular form?" These were the answers:

Practically Never	40%
Always	9%
Sometimes	51%

The majority of the answers indicated that textures were used sometimes to emphasize a particular form because they affect light reflection.

Coarse rough textures absorb more light. They seem darker because of tiny shadows which are cast across the surface. With diffuse lighting shadows lessen and the surface in turn loses some of its textural quality. When choosing fabrics with a pile surface, such as a pile carpet, they should be viewed from all directions, since color values will differ depending on which way one looks into the pile. Light reflected from a smooth polished surface is bright and sharp. Thus it can be used in emphasizing a form.

Favorable reflections of walls, ceilings and floors help to establish

visual comfort. The ratio of the light reflected by a surface to the light falling on it is known as the reflection factor. A smooth material has a higher reflection than a rough material. Since the textures of materials have weight, the rougher, heavier materials are widely used in the lower part of a room.

Walls, ceilings, floors and furnishings are an integral part of lighting design because of the way they absorb and reflect light. Matt finishes are preferable for these surfaces. They help prevent excessive brightness ratios. Large areas of glossy finishes may be distracting and uncomfortable because of specular reflections. However, small amounts from smooth materials, such as glass or polished metals, can add the sparkle needed in an interior.¹

Materials Regulate Sounds. Materials are classified as sound-reflecting or "live" if they cast back sound, as does wood, plaster, or glass; and as sound absorbing or "dead" if they swallow up sound, as do heavy draperies, books, or accoustical materials.

Answers to question 12, "The characteristics of materials determine the degree of absorption and reflection of sound in the homes. For example, thick materials tend to absorb more sound. How often have you felt such effect?" were as follows:

Practically never	31%
Sometimes	54%
Always	15%

¹Magdalene Elisabeth Pfister. An Exploratory Study of the Effects of Lighting Upon Space, Form, Color and Texture. (Unpublished Master's Thesis). Cornell University, 1961. pp. 54-57.

Finally, the result of this question also showed that materials determine the degree of absorption and reflection of sound in the homes.

Sound travels through air and through solids. When sound strikes any material in our homes some is absorbed, part is reflected and the remainder is transmitted to other parts of the home. Materials having the component parts closely compacted together tend to reflect sound back into the room. Porous materials absorb most sound if thick but transmit noticeable amounts if thin. Materials can absorb, transmit, or reflect sound. A dense insulating wall, for example, masonry, lessens sound transmission from one room to another but causes sound to reverberate in the room where it originates. Absorptive materials, such as porous wallboard, soak up some reverberations, but if thin, allow sound to travel through the wall. Absorptive material lessens sound reflection in a noisy room.

Favorable sound absorptions of walls, ceilings and floors help to establish physical comfort. Sound absorption results from resilience; thus, rugs rate high on this quality.

The amount of sound absorbed or percentage is termed as the coefficient of absorption and the amount or percentage of sound reflected is termed as the coefficient of reflection. It is the coefficient of absorption which determines the suitability of any material as an effective sound insulator. One hundred per cent absorption will be effective in the case of the open-plan. Thus, the structure and the surface of sound-insulating materials must be an absorbent one and not reflecting.¹

¹Price Re Eight. Properties, Processes and Uses of Engineering Materials. London: D. D. Gangal, 1962. p. 208.

Materials Provide Physical and Psychological Durability. The degree of durability and maintenance of any object is affected by the structural and surface qualities of its material. It has been said that the amount of time and money taken by materials determines their satisfaction. Thus a satisfactorily designed home makes use of standard materials for maximum economy.

Everything in the home should be easy to clean and to repair. Smooth surfaces with a visual textural pattern, such as naturally finished woods, combine the best characteristics of smooth and rough surfaces. They call less attention to foreign matter than smooth shiny surfaces and are easier to clean than rougher ones.

The length of service of any material depends on its physical and psychological durability.

Physical durability is determined by the construction and finishes of materials. For example, strong materials with firm construction lessen repairing. Durability of finish and ease of refinishing are important. Painted wood may need new paint every few years, and upholstery fabrics may serve from two to twenty years, or more, depending on the quality of the material.

Psychological durability is determined by giving continued satisfaction to the beholder. Avoid revivals and choose materials which are flexible and seem right for you.

Materials Control Temperature. The materials in our homes and the way they are put together are basic factors in determining the degree of insulation. One can, from the start, design a room, its orientation and material selection in such a way that temperature can be controlled.

Our physiology permits us to notice the differences in near-by materials. Some of them absorb the body warmth; some are mirrors which seem to reflect our own heat rays. Some are heat gatherers, such as wood; and others conduct heat away from us, and thus are cool. Smooth materials seem cold, and rough ones look warm. For example, a chair upholstered in wool looks warmer than one of metal and plastic. Also a room with wall-to-wall carpeting looks warmer than one with a small rug.

Materials Give Clues to Distance. The degree of enclosure or openness is determined by materials and their textures. Enclosure is brought about by opaque and noticeable textures. Openness comes with a maximum of transparent, translucent or apparently thin unobtrusive walls and a minimum of walls that block the view or movements. Thus, using glass in large areas helps to increase the apparent distance. With the addition of the glass curtain wall, our homes have not only benefitted by the increased amount of light, but the out-of-doors has become part of the house, thus increasing the visual and emotional space within. It is possible for the same amount of space to seem cramped in one arrangement and comfortable in another.

Plate XVI, Fig. 1, illustrates that the textures of materials give clues to distance. The coarser the texture, the nearest it seems to the beholder.¹

Materials Affect Each Other. The apparent fineness or coarseness of a texture is greatly affected by its background. Plate XVI, Fig. 2,

¹Birren, op. cit., p. 28.

EXPLANATION OF PLATE XVI

Figure 1 illustrates that the texture of any material gives clues to distance. The coarser the texture, the nearer it seems to the beholder.

(Taken from Faber Birren. Color, Form and Space. New York: Reinhold Publishing Co., 1961. p. 28.)

Figure 2 illustrates that the apparent fineness or coarseness of a texture is greatly affected by its background. Here (A) seems a little coarser than (B). (Taken from Ray Faulkner and Sarah Faulkner. Revised edition. Inside Today's Home. New York: Holt, Rinehart and Winston, Inc., 1960. p. 132.)

PLATE XVI

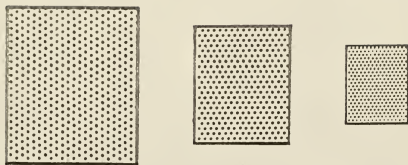


Fig. 1

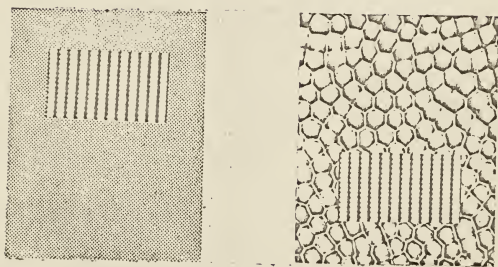


Fig. 2

illustrates that a smooth texture looks smoother when seen against a rough texture than it does against a smooth one. In brief, moderate texture contrasts tend to reveal textures in their true characters. Strong texture contrasts tend to separate objects while minimum contrasts unite them. This is an observation applicable to many phases of home design.¹

A brick fireplace stands out from a glass wall, while a wool sofa will become allied with it. If we have a lamp we wish people to notice it should be placed against a background of contrasting texture. If it is desired to minimize its outline, it should be placed against a wall of the same texture.

CONCLUSIONS

While most of the conclusions concerning the environmental aspects of forms and materials in residential design were given with each aspect in the general discussion, those concerning the larger aspects of this study are herein presented in order that all previous information can be drawn upon.

Early in history forms and materials were considered as fundamentals in residential design. Today, we have become more aware of their potentialities, beyond pleasantness and unpleasantness. The home of today is built of new materials and with new forms and methods of construction. An ever-increasing variety of forms and materials in residential design have arisen to meet the creative challenges of the present developing era. However, some of the primary structural forms and materials, such as

¹Faulkner and Faulkner, op. cit., p. 132.

rectangles and circles made of stone, wood and brick have persisted until the present time.

A design for beauty, functionality, economy and individuality has no rigid standards. At its best each form and each material seeks and finds its own appropriate order. However, a few principles are basic to applied residential design in order to achieve the desired effects.

Interest and beauty in the home can be built up by using unexpected, or worthy collections, or contrasts of forms and materials in a unified composition. Without these features a home is dull and monotonous; with them in excess, it lacks unity and becomes confusing and restless. Every composition in the home must be characterized by a connection between all its components. Equivalent forms, identical materials and those articles that the eye can easily divide into two equal parts must be avoided.

Each form and each material in the home should be capable of performing its functions. Study and analysis of specific and general functions are important in selecting and designing these elements.

Residential forms and materials should be in equilibrium since this gives a sense of stability. In home design an asymmetrical balance in the arrangement of symmetrical forms and materials is more preferable as an environment for the informality of the space; as well as providing more freedom and flexibility. However, symmetrical arrangements are recommended for focusing attention on something important and contrast with the surroundings is sought.

Residential forms and materials should also be designed so as to be in scale and in proportion with the human body, the surrounding space, and

the environment. This helps to establish comfort and beauty since the eye tends to judge shapes and forms in terms of surroundings. The same form gives different impressions to different people, depending on how, where, and when this form is used. Stable forms are more easily appreciated. Forms seen in the upper part of the visual field tend to look relatively smaller and heavier. Temperaments, interests and attitudes direct and determine the appreciation of any form.

A good residential design is that which can give space its full value. Instead of tightly enclosed boxlike rooms, space should be organized as a continuing flowing entity, designed for diverse purposes. Thin and freely movable internal wall partitions are preferred. Furniture should be limited to those really needed. Large glass areas give illusions of space.

A good design makes use of the available materials. A wide range of textures is preferable. Walls and ceilings with their moderately smooth surfaces, against which very rough and very smooth textures are accented are predominant in any room.

Finally, a good design shows favorable absorption of sound, light and heat, resulting from the dominant quality of materials used throughout the home.

SUMMARY

This study was concerned with the best ways to use forms and materials in residential design to provide an environment for satisfactory living.

Forms and materials are the major elements in residential design which comprise our visual environment.

Recently, the need for research into environment has become very apparent.

One hundred copies of a questionnaire were prepared and submitted to Cornell University students in order to obtain first-hand information, and library research was conducted so as to evaluate this study. The results of the questionnaire were discussed.

Some aspects of the past and of the present forms and materials used in residential design and the factors which made up that history were considered.

A house should be designed to satisfy the needs of the living environment.

Good design shows variety in unity, balance, rhythm, scale and proportion.

Use, beauty, economy and individuality of forms and materials should be considered to give a satisfactory design.

Simple forms are the most satisfying ones.

The size, shape and direction of any form are important factors in bringing about desired physical and psychological reactions.

The physical properties of materials determine their possibilities and limitations.

As an example of the principle of good residential design, a living room was planned and set up so as to show integrated and well organized composition of forms and materials. The same principles should be applied in all rooms of the homes.

ACKNOWLEDGMENTS

The author wishes to express to her major advisor Professor Jack Clyde Durgan, and members of her committee: Dean Emil C. Fischer, Dr. John Frederick Helm and Professor Alden Krider of the College of Architecture and Design; Professor Esther Cormany of the Department of Home Economics; at Kansas State University; Professor G. Cory Millican of the Department of Housing and Design at Cornell University, and to the Cornell students, sincere appreciation for their cooperation.

She also wishes to acknowledge the encouragement of her husband, Mosain Mahdi Al-Hassani, and the kind assistance of her friend, Julia Maxine Hite.

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APPENDICES

APPENDIX A

Table 1. Requirements for the performance of some common activities in a living-sleeping room in college residence halls.¹

Activity	Total Area				Furniture
	Females		Males		
	Depth	Width	Depth	Width	
			Inches		
Sitting in straight chair	32	18 1/4	36	22	Straight chair 20"x18"
Getting up from straight chair	33 1/4		38 1/4		
Sitting in straight chair, legs crossed	38 1/2		42 1/2		
Sitting in rocking chair	42	22 1/2	46 1/2	22 1/2	Rocking chair 32"x22"
Getting up from rocking chair	42 1/2		50 1/4		
Sitting in rocking chair, legs crossed	46 1/2		50 1/4		
Sofa and coffee table	71 1/2		75 1/2		Single bed 40"x82"- coffee table 20"x 30" or 30"x30"
Sitting at card table	45 1/2		50		Card table 30"x30"- Chair 22"x18 1/2"
Getting up from card table	58 1/2		60 1/2		
Listening to radio	49 1/2	52 1/2	51 1/2	54 1/2	Upholstered chair 34"x34"
Getting up after listening to radio	49 3/4		53 3/4		Radio 13"x26"
Reading newspaper	45 3/4	49	49 1/2	50 1/4	Upholstered chair 34"x34"
Getting up from reading newspaper	47		51 1/2		End table 14"x22"
Reading newspaper, legs crossed	50 3/4		53 1/4		
Sitting at desk writing	47 1/4		48 1/2		Desk 30"x44"
Getting up from desk	57 1/4		59		Chair 22"x18 1/2"

¹Center for Housing and Environmental Studies, Ithaca, New York. Cornell University, 1959. p. 73.

APPENDIX B

A STUDY OF RESIDENTIAL DESIGN ON
CORNELL UNIVERSITY STUDENTS

119 Eddy Street
Ithaca, New York
November 10, 1964

Dear Cornell Student:

- 1) This study deals with residential design. I would like to know what are the "Environmental aspects of forms and materials, and their effects upon you as a resident." This is part of my master's thesis in the College of Architecture and Design at Kansas State University. Please think only of yourself as you answer the questions.
- 2) Most of the questions can be answered simply by placing a check () on the line beside the answer which best describes your feeling and your satisfaction. If you feel that none of the answers are adequate, please indicate your suggestion.
- 3) Many of the terms used to discuss residential design have different meanings in different fields. The following definitions of words directly related to this study were considered:

Form - three dimensional shape or structure. It is the counterpart of space.

Space - the emptiness, or interval between things.

Texture - surface quality of any material; the tactile and visual characteristics may be described in such ways as rough, smooth, pliable, rigid, fine or coarse.
- 4) When the questionnaire has been completed, please return it in the stamped envelope as soon as possible.

Thank you very much your your cooperation.

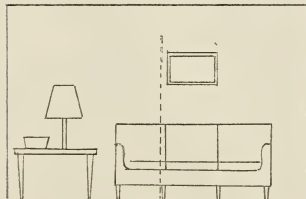
Sincerely yours,

Amel Al-Hassani

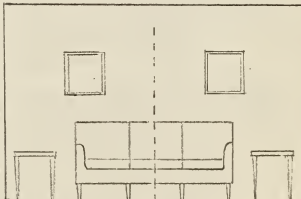
APPENDIX C

RESIDENTIAL DESIGN QUESTIONNAIRE

- 1) Do you feel that selection and organization of forms and materials are the first consideration in residential design?
- _____ "Yes," because, thoughtful selection and organization of forms and materials create beauty and functionality.
- _____ "No," because, other factors such as light and color should first be considered in residential design.
- _____ Other, indicate _____
- 2) What makes a piece of furniture, or a particular room, or a special house satisfactory to you?
- _____ If it is functional; meets my needs and requirements.
- _____ If it is beautiful; gives me pleasure.
- _____ If it is economical; easy to clean and to repair.
- _____ If it is individual; has a character of its own.
- _____ Other, indicate _____
- 3) In the room below, there are two types of arrangements: Asymmetrical and symmetrical. Which one do you prefer to be in your room?
- _____ I prefer (A) because asymmetrical allows full freedom and flexibility, since unlike forms are placed at unequal distances from the center.
- _____ I prefer (B) because symmetrical can be seen quickly, since one side is the exact reverse, and at equal distances from the center.
- _____ Other, indicate _____



A



B

- 4) Does any part of your house, or your apartment, or your room call your attention more than another?

 Yes

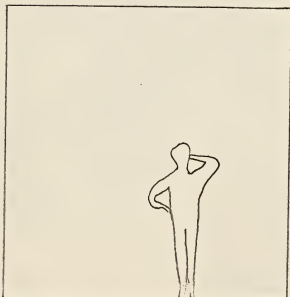
 No

If "Yes, what factor does make it attractive?

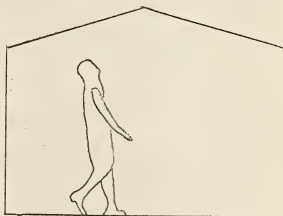
- Holds the largest forms and/or materials.
 Contains unexpected forms and/or materials.
 Contains worthy collections of forms and/or materials.
 Contains contrasts of forms and/or materials.
 Other, indicate _____

- 5) Ceiling height and shape are determined by resolving our needs for head room, air to breathe, and economy with our desires for space pleasantly proportioned and in character with our living. In the three rooms below there are three kinds of ceiling A, B, C. Which one do you prefer for your house?

- I prefer (A) because, high ceiling provides a feeling of loftiness and greatness.
 I prefer (B) because sloping ceiling provides environment suggesting activity.
 I prefer (C) because low ceiling provides comfortable, relaxation, and is more economical.
 Other, indicate _____



A



B



C

- 6) Different types of geometrical shapes have different effects upon us. Which types do you prefer to dominate your house?

☐ I prefer rectangular forms because they are more stable and simpler than other forms.

☐ I prefer circular forms because they are self-contained and they produce the effect of movement.

☐ I prefer triangular forms because they introduce excitement and adventure, direct attention along the diagonal, and call attention to corners.

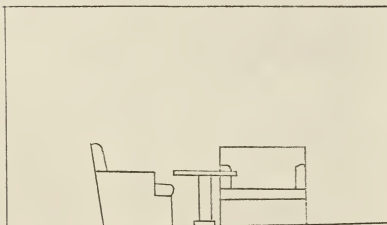
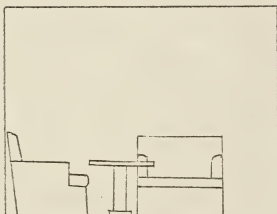
☐ Other, indicate _____

- 7) The apparent size and shape of any form in a house is determined by its relation to the space around. For example, in the two rooms below, the two chairs and table look smaller in the big room than in the small room. Have you ever noticed that?

☐ Never.

☐ Sometimes.

☐ Always.



- 8) If your room is small, what do you think will make it look larger?
- ☐ I limit furnishings to those really needed.
- ☐ I keep dominance to a small scale both in forms and in materials.
- ☐ I use large glass areas.
- ☐ Other, indicate _____
- 9) Our houses are built of materials, each having special potentialities and limitations that indicate appropriate forms, uses and effects. Which of these materials do you prefer to be dominant?
- ☐ I prefer wood because it is adaptable to many forms.
- ☐ I prefer stone because of its natural texture.
- ☐ I prefer glass because it creates indoor-outdoor relationships.
- ☐ I prefer concrete because it can be cast in varied shapes.
- ☐ I prefer brick because of its durability.
- ☐ I prefer other, indicate _____
- 10) The texture of the material affects us physically in everything we touch. For example, upholstery fabrics, if coarse and rough, can be irritating. If too smooth and shiny they look and feel slippery and cold. How often do you feel such effect?
- ☐ Practically never.
- ☐ Sometimes.
- ☐ Always.
- 11) "Texture" affects light reflection and thus the appearance of any form. Very smooth shiny surfaces, such as shiny polished metals, reflect light, attracting attention and making their colors look clear and strong. How often have you used such effect to emphasize a particular form?
- ☐ Practically never.
- ☐ Sometimes
- ☐ Always.
- 12) The characteristics of materials determine the degree of absorption and reflection of sound in the homes. For example, thick materials tend to absorb most sounds. Have you ever noticed that?
- ☐ Practically never.
- ☐ Sometimes.
- ☐ Always.

AN INVESTIGATION OF THE ENVIRONMENTAL ASPECTS OF FORMS
AND MATERIALS IN RESIDENTIAL DESIGN

by

AMEL SADIQ AL-HASSANI

Diploma, The University of Baghdad, 1957

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ART

College of Architecture and Design

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1965

This study proposes ways in which forms and materials may be used in residential design for satisfying the occupants' needs. It shows that forms and materials need to be integrated into all portions of the living environment, and to do this successfully they must be planned from the beginning.

During this study, forms and materials were isolated from each other and from the total design. This helped to focus on their effects. Library research and a questionnaire distributed among Cornell University students brought the following data which are applied to residential design:

A house should be designed for satisfying our physical and emotional needs. Organization of forms and selection of materials should be the first consideration in residential design. Interest in a design is attained by the introduction of contrasts. Good design shows variety in unity, and a unified house satisfies the desire for secure atmosphere. Use, beauty, economy, and individuality should be considered to produce a satisfactory design. An asymmetrical balance is more preferable to be used in home design as an environment due to the informality of the space. Scale and proportion are essentially methods of relating design to environment.

The most satisfactory forms are the simple ones. Stable forms are easier to perceive. The size, shape and direction of any form determine our physical and psychological reactions. Seldom is any form seen in isolation from space. There are no limits to the ways in which forms can be varied and combined for specific desired effects. Rectangularity is typical of the largest forms in homes today.

The possibilities and limitations of any material are determined by its physical properties. Materials affect us physically in everything

we touch, smell, taste and see. The kind of surface of any material determines the way light is reflected. Favorable sound absorptions of materials help to establish physical and psychological comfort. The satisfactorily designed home makes use of standard materials for maximum economy. The materials and the way they are put together are basic factors in determining the degree of heat insulation.

A historical background which deals with some aspects of the past and present forms and materials in residential design and the factors which have made up that history are considered.

A designed living room shows a well organized composition of forms and materials integrated into a gracious setting for home life. Traced illustrations are presented to explain some aspects of forms and materials that should be considered in creating a good design.

The purpose of this study is to establish principles upon which forms and materials depend for producing a good design. These principles will be applied to future residential design.

